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'*Knowledge is proud that he has learned so much,*
Wisdom is humble that he knows no more.'—COWPER.

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Hygiene.

BY ALFRED CARPENTER, M.D., M.R.C.P. (LOND.), C.S.S., CAMB.

Personal Hygiene.—Under this head are included a series of influences which affect the health of the individual from causes over which he has comparatively little control—indeed, in some of them, none at all—such as the influence of age, sex, habits, temperament, idiosyncrasy, heredity. The influence of occupation upon health may also be considered in this section.

Age.—This is an important factor in various ways. Unless there is some general indication as to the numbers of persons at different ages in a given district, it is quite impossible to arrive at a proper appreciation as to its healthiness or unhealthiness by a study of the mortality tables, especially if the area under consideration is small. The accidental establishment of a large school for children, of an orphan home, or an asylum for aged people, may alter the true state as deduced from a statistical study. Age, therefore, is to be considered in regard to the number of deaths in a particular area. The mortality among infants is very large, especially among the poor—largest of all among those children who are illegitimate; so the birth-rates of a given area must be taken into account in dealing with this question, which will come in for more consideration in the section on vital statistics. Age influences disease; young children are subject to a different class of disease to those who have passed the meridian of life. The baby is affected by disease caused by the character of the food, whilst older people are less influenced by it. They are also more liable to the zymotic class, because they have not yet suffered from its incidence. The aged rarely suffer from the effects of zymotic disease because they are either unsusceptible of its attacks, or have already been affected by all the class, which do not generally recur in the same individual. Those who have passed the middle periods of life begin to suffer from wear and tear, from the failure of the different excretory organs to keep the fabric of the body in a purified condition. *Débris* is left *in situ*, and lays the foundation for those disturbances which set up chronic disease. Young people pass through some kinds of serious illnesses without danger or without injury, whilst older people succumb, because their organs are more or less damaged by deterioration, by misuse or by actual decay. Some periods of life are more susceptible than others; thus teething children are more easily upset by diet or bad food. The female frame is disturbed by the action of organs peculiar to the sex, which leads to disturbances at the commencement of womanhood. They have to suffer the dangers of childbirth, as well as at the so-called climacteric period, when it ceases to be with them after the manner of woman, and the time for child-bearing is gone by. This climacteric period affects men as well as women, but not to the same extent. *The habits* of an individual are much influenced by his age. The child is mercurial, volatile, and restless, the aged sedate and calm; and the habits very frequently determine the healthiness or unhealthiness of the being. A child which is too sedate is not so likely to grow up healthy and robust as the mischievous and restless child. Exercise is necessary for health, and no child can be well which does not take abundance of it; whilst in age it is not so absolutely required. Growth and development require the energetic and continued removal of *débris*, which exercise alone can effect. In age the body is already built up, and it is the mental faculties and functional work which have to be performed, and which do not leave so much to be removed as is the case in those changes which are consequent upon growth and development. No child can grow up with a clear brain unless there is regular sleep; regular sleep will not come unless the muscular system is tired out by exercise. Hence, Nature implants a mercurial tendency in youth, which departs as people grow old. The young child consumes much more food, weight for weight, than an older person; for this reason, it requires to be fed at shorter intervals—a fact which is sometimes forgotten in our public establishments. It is in youth that our habits (which will hang to us for the rest of our lives) are formed, and it is important, in the interests of health and morality, that those habits should be healthy and moral. It is in the power of the nurse to corrupt the child's morals, almost as soon as it can walk. It is impossible for the child to grow up in purity if the first companions

are lewd and without modesty. Much of the mischief which is produced in the nervous system of boys and girls, by which they become necessarily impure in thought and act, is the result of the action of the nurse in trying to lull a restless child to sleep. A large number of young men are utterly unable to state when they first became unchaste, because the first commencement of impurity began before they were out of the nursery. Chastity both in male and female should be earnestly inculcated, as without it a nation must necessarily degenerate both in mind and body. *Principiis obsta* is especially necessary in dealing with this important, though uncomfortable, side of the subject. The habits of the individual influence his future in various ways which are intimately connected with the first departure from purity of life. Mental depression, loss of power, and certain forms of insanity are intimately associated with the cultivation of bad habits, by means of self-abuse, which can only be combated by prevention in the earliest periods of life.

Sex.—This influence bears upon vital statistics, and will be dealt with in its general aspect in that section. It was supposed that there were more females than males born into the world; but this is not so, the excess in this country is the other way, although in some States there is a great excess in female life. There is an excess in the death-rate of males over females to the extent of nearly two in the thousand. In some places, as Liverpool and Manchester, this is nearly doubled, and in some the deaths of male infants is greatly in excess of females; and later in life there is a greater mortality among males than females, from the accidents of life, especially those connected with occupation, and the emigration of males to a larger extent than females, and also to their employment abroad in the public service and in foreign countries. It follows, therefore, that as time passes, the number of old women is in excess of that of old men. The average length of life is also greater among women than among men. Then, again, in some towns female labour is more in demand than that of males, and there is immigration from the rural districts to meet this demand. There is a superabundance of women in the wealthy districts of the land, from other causes; and in well-frequented watering places they are found in excess, because there is more employment for them. Men die faster than women, because they are more exposed to the influences which cause death by accident, or set up disease; occupation having something to do with this result. The proportions of the sexes vary in different localities, from causes which will be manifest from the preceding observations. Life is safer in domestic employment than in a large portion of the industrial occupations in which men are employed, although females are liable to the dangers incident to childbirth, from which men are free. There are many points, in considering the influence of sex, which may give rise to fallacies in drawing deductions. The number of males and females vary very much at different ages. Country districts differ from cities in this matter; the excess of one sex in one place will not correspond with the excess in another; this has been shown very clearly by statistics drawn up by the Registrar-General. Towns contain a larger number of persons of a marriageable age than rural districts. It is found that the age of the mother of first children averages a lower rate in towns; but it does not follow that persons living together in crowded centres, under conditions of moral degradation and physical degeneracy, have a greater fecundity than those in opposite states; for it is probable that the clergymen of the English Church—who, as a class, are the least wealthy of the professions, but who are cleanly and moral—have the largest families of any class of persons in the kingdom.

Temperament.—This term has reference to the state of the constitution with respect to the predominance of different qualities. The ancients acknowledged four kinds—the sanguine, the choleric, the phlegmatic, and the melancholic. Each was supposed to impart its peculiarity more or less to every individual. The division may be used now, with some qualifications. Those of sanguine temperament are of predominant activity, with fair or light hair, easily take on inflammatory action, are susceptible of great exertion, and look upon the pleasures as well as the evils of life with a hopeful eye. Youth is more sanguine than age.

The choleric or bilious temperament have a vivid and easily excited sensibility, skin often brown, hair dark, form harshly expressed, passions violent, full of boldness and activity, irascible and impetuous both as to good and evil. This temperament is liable to become melancholic when the biliary organs become depressed and their action interfered with; the functions are then feebly and irregularly performed, general uneasiness affects the mind, the skin takes on a deeper hue, the face becomes uneasy in its aspect, the imagination becomes gloomy, and the person suspicious. There is distrust and fearfulness, with opposite conditions to the sanguine and choleric.

The *nervous* temperament expresses a property of being more or less easily sensible to impressions, both centric and eccentric, than those which arise within the brain as well as those which come from without. It is nothing in the athlete, scarcely seen in the sanguine, comes out more easily in the bilious, and most manifest in the melancholic. There may be vivacity of sensation, but there is usually slimness of figure, with sudden change of idea and defective and changeable judgment. To these we must add the *Insane Temperament*, characterised by eccentricities of thought, feeling, and action. He is self-exalted, his work and opinion is of greater value than anybody else's, his feeling is quite unlike other people's—it often borders closely upon genius—and even wit of a brilliant character is often allied to madness. Genius is in the van of progress, and it necessarily differs from the ordinary run of people. It is often thought to be mistaken and insane, though truly correct. But the originality of a man of true genius differs from that which has an insane tendency, in much of the latter not being original. But these are definitions somewhat beyond the scope of my object, which is to show that certain deductions may be drawn from temperament which may influence the custom and habits of a people, and indirectly lead to good or bad hygienic conditions.

Idiosyncrasy is a condition of body when there is a particular inclination or aversion to some one or more things, such as the predisposition to disease, as seen in gout or rheumatism. Some persons cannot bear certain kinds of smells without being made faint by them; others are affected by minute doses of medicines or foods, which are not at all perceived by the majority

of people. Some have peculiar aversions to objects which are quite unexplainable, and these antipathies are said to be idiosyncrasies. These show themselves sometimes even without the aid of material objects, and are brought into being by mental action alone, so that the mere name of a cat or a particular kind of scent produces an instant effect. These conditions are of more consequence to the physician than to the hygienist, but nevertheless the sanitarian must be aware of their existence.

The influence of hereditary agencies is much more general and decided. It requires to be fully considered.

(To be continued.)

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How to Teach History.

BY ISABELLA LANDALE.

(Continued from page 342.)

The hard realities of life which begin so soon to press on children attending common schools, are not favourable to the growth of imagination, therefore its development in their school-years should be specially attended to.

Width of view is to be understood not only as the power of seizing the broad and salient features of universal human nature, but also in its other aspect, as the power of sweeping over multitudes of unimportant particulars, and rejecting those details having no bearing on the vital points which govern human affairs. Here it is that the ordinary mind fails —becoming distracted and confused by the number of lesser incidents which surround the chief events; and here come into play the advantages to be derived from another part of our system, *i.e.*, the importance attached to epitomes and to practice in the mode of forming them. Though this power is, in many instances, a natural gift, yet it may be to a great extent acquired as a mental habit, and its acquisition as such would be much assisted by a practice (extended over several years) of our method, in which the pupils are led, by skilful questioning, to discover for themselves which are the most important events in the period of history they have been studying, and to reject those which are unnecessary. Having thus been accustomed for years to generalise on familiar ground, and under the direction of a competent guide, they would be less likely to attempt rash generalisations on subjects of which they knew nothing. No mental habit is more dangerous than that of ignorantly rushing to conclusions without first studying all the bearings of the question.

Width of view, however, is pre-eminently the privilege of the mature mind, and it is the work of the student after leaving school which will have most effect in its attainment, especially it there is a wise scheme of study in the selection of the books read. Otherwise it would be possible, by studying only certain authors, to acquire bigoted and narrow-minded views instead of those at which we are aiming. Such students would find many useful hints in Dr. Arnold's 'Lectures on History,' especially in his directions for its systematic study. With our rapidly growing advantages of free libraries and cheap books, even the young artisan could carry himself successfully on. For girls who have left school, and for all those whose time is not at their own disposal, and whose only hours for study are necessarily irregular, the new system of instruction by correspondence would be invaluable, not only because of its thorough and admirable method of imparting knowledge, but because its regularly recurring demands secure the continuity of study in spite of the irregular hours for preparation caused by the necessary distractions of domestic duties. The books to be studied vary with the circumstances of the student, as is the case with the choice of countries to which the attention is to be directed. It would be well, at all events, to study the history of those countries with the inhabitants of which we are likely to have most intercourse, that we may be able to cultivate feelings of international sympathy, which is so powerful a means of improving our relations with other countries, and in which, owing to our insular position, we are perhaps more deficient than other Europeans. Bad feelings, between nations as between individuals, often arise from mutual misconceptions of character, which would be removed on better acquaintance.

There is, perhaps, no readier way to the heart of a foreigner than that formed by a knowledge and appreciation of the history and literature of his country. To take our own empire of India as an illustration: we believe that the great and growing appreciation of the ancient Vedas shown by Englishmen will do more to create a feeling of sympathetic interest between the conquerors and natives of India than all the direct efforts hitherto made to obtain the confidence and friendship of the Hindoos.

Widely diffused knowledge of the history of foreign countries would certainly lead to a kindlier interest in their inhabitants, and would perhaps prevent that distrust or suspicion which is so often the cause of war. It is believed that more wars arise from the general state of feeling in the people of a country than from the convictions of its statesmen, who are obliged so far to yield to violent popular prejudice. These currents of hostile feeling are often due to the people's ignorance of history—an ignorance which is equally serious when considered in its other relations, and leads us now to study

The Bearings of History on Politics.

Education of Public Opinion.—This is one of the most useful aspects of history, and one which grows daily in importance, for the wider the extension of the franchise, the more necessary the culture of that public opinion which governs the country through its representatives. It is often said that an aggregate of the selfish interests of individuals forms the most powerful motive in politics; but even if such be the case, we are fortunately saved from the consequences of universal selfishness by the fact that the variety of interests in a state is so great that it tends to prevent the undue influence of any. So that, to provide for 'the greatest happiness of the greatest number' becomes as much a necessity for the mere worldling (as the best means of providing for his own comfort and safety) as it is, for its own sake, an object of devotion to the philanthropist. In trying to reach this goal, the bearings of history on politics are most important, especially in such directions as the improvement of laws, and the prevention of unnecessary wars.

As our principal object has been to indicate the

method of studying history, we have not gone much into the different divisions of the subject to be studied, leaving them to be settled by a principle of natural selection. The portions of history suitable for young people are, as a rule, those which interest them most, and the two subjects we have just mentioned as closely affecting politics belong to the class of information which is only interesting to grown-up people. Of course there is imparted to a child, in the school course of history, a certain knowledge of the gradual formation of his country's laws, and also of the various causes that have led to wars, but not such a knowledge as to have much effect on his political opinions in after life. These are doubtless affected to a certain extent by the culture his mental faculties have received in the history course, which has failed in its object if he is not in consequence a better man and a better citizen, but it is only the study of riper years which materially affects a man's political opinions.

It may be argued that improvement of laws and prevention of unnecessary wars are not the business of the individual but of the government; but that will not be agreed to by those who believe in the growing power of public opinion. As the exercise of power involves responsibility to every conscientious mind, the responsibility of each man for his political opinions becomes an article of modern morality, and the deliberate cultivation of sound views on the subject of government a public duty. The way in which we propose to effect this deliberate culture by means of history is by using another form of the same method employed to effect the other ends we had in view, namely, by the comparison of the past with the present, and (especially with the present in the form of contemporary history) as a solid ground for future operations.

In a study like this our comparisons are naturally more with past events of recent occurrence, therefore modern history is generally considered the most instructive field in which to gather information in political questions.

Bearings of Ancient History on Politics.—Dr. Arnold, however, holds that, at any rate to begin with, a clearer idea of the action of political parties is gained by a study of ancient history, because there the political elements are not so complicated as in modern times. And his son argues (in 'Higher Schools and Universities in Germany') that the capacity of Englishmen for rule and organisation, both in public and private situations, is greatly caused by their familiarity with classical studies in childhood, which has influenced their minds for years, by bringing them into close contact with those ancient nations who ruled the world. Whatever the field of study, however, the great aim should be to watch the process by which laws have been formed, the nature of the laws themselves, and their result in procuring the greatest happiness of the greatest number.

One great benefit to be derived from such study is, that by it we learn to judge of political subjects with a calmness and impartiality which it is difficult to acquire if our judgment is brought to bear on the questions of our own day only, for there our interests may unduly influence our conclusions. This attitude of impartiality, so necessary in the pursuit of truth, is very difficult of attainment in modern times, as we are all more or less swayed by the opinion of the newspaper we read, which is generally the organ of a party: indeed, we might be little better in this respect in studying history, if we did not take care that our historical reading is wide enough to embrace authors of different views.

Prevention of Wars.—The other division of the subject to which we have directed attention, that of the original cause of wars, would be one of great practical utility when brought to bear on the subject of our disputes with other nations, which could often be settled without war if treated with the calm impartiality of an educated and enlightened public opinion.

The tracing of these causes, however, is, it must be confessed, a difficult operation, and perhaps will not be clearly understood until there is a greater advance made in the highest form of our subject.

The Philosophy of History.

Final Results of such Training as a means of Perfecting the Science known as Philosophy of History.—The philosophy of history, in a scientific form, is a study of comparatively recent origin. It has, no doubt, arisen from the discoveries made in modern times in the regions of physical science, which have so accustomed our minds to glorious perfection of design, order, and law in all the Divine workings in nature, that we are led to expect the same in human affairs, and to have a firm faith that, out of the tangled perplexed web of history, will arise more and more clearly the designs of an over-ruling Providence. It is true that such a faith has been the joy and hope of the world for ages, but in a comparatively dim and uncertain form suited to the earlier development of the race, which seems only now approaching the period in which its powers are sufficiently developed to begin this noble study. For, if we look on mankind as a collective whole, gradually advancing in knowledge and capacity, as Lessing does in his 'Divine Education of the Human Race,' we may, perhaps, without presumption, suppose that we are now approaching the age of manhood, so that we may venture on studies which could only be undertaken after the 'Zeit Geist' had advanced to a high state of culture. So much is this the case, that the introduction of such a subject at all into an essay expressly devoted to the school-teaching of history seems at first sight utterly out of place; but as we consider the matter more deeply, we see that there is, after all, an intimate connection between the two.

How is School-teaching connected with the Philosophy of History?—If it be conceded that the ultimate aim in the study of history is to understand, as far as we can, the meaning of human life, and to trace the workings of Providence, that we may apply its teaching to our daily lives, we are not worthy to be 'the heirs of all the ages' if we do not learn to make the best use of their accumulated stores of experience. So, if we look on the philosophy of history as the highest form of such endeavours, it becomes an important matter to educate children so as to bring them up to a platform high enough to be ready to receive such teaching after they reach the full development of their powers. For the deepest truths and the wisest words which are far in advance of their time have no more effect on those who hear them than 'the sounding brass and the tinkling cymbal.' It is not given to all to be the leaders of thought, and, as it were, the exponents of

a further revelation; but the humblest can help to prepare the hearers, and, at least, bring them to the heights where the prophets speak.

In the whole range of science there is, perhaps, no more fascinating subject than this; and here lies the great danger—that of being carried away by the fascination of the subject into rash and false generalisations from imperfect knowledge—a danger which has already been but too well exemplified by some brilliant writers on the philosophy of history, and by the effect their writings have had.

Sound Knowledge on the part of the Public a Safeguard against the False Generalisations of Brilliant but Untrustworthy Writers.—Now, the best safeguard against the dangers of such misleading books is to be found in the check supplied by more accurate knowledge on the part of the readers. The grasp of mind necessary to generalise profoundly on a subject so vast and complicated as that of history is possessed by few, but it is within reach of all to attain to the humbler level of a knowledge of the facts from which generalisations are made; and the more widely diffused such knowledge, the less risk of a common acceptance of conclusions which have been reached by a perversion of some facts and an ignoring of others. It can only be after a thorough and accurate method of studying history is the universal result of school education that any real progress can be made in its philosophy.

Co-operation of Average Minds necessary to Provide Materials for Leaders of Thought.—The immense range of the subject can only be overtaken by the universal co-operation of minds trained to thoughtful study, and to habits of comparison and inference. As the science of meteorology, which has attained such wonderful results, has been gradually formed from conclusions taken from an aggregate of individual observations in all parts of the world, so the science of historical laws can only be evolved out of the accumulated examples and inferences supplied by individuals in every department of the subject, from which materials the greatest minds may discover some of the laws which govern history.

Buckle, in discussing this subject, says: 'Another cause which has retarded the creation of the science of history is that the historian is unable to employ the great physical resource of experiment by which we can simplify even the most intricate problems in the external world.'* The same difficulty, however, had to be surmounted in the science of human physiology (though it may be considered fanciful to trace the analogy between them); there is the same impossibility of dissecting living specimens, the same power of learning from inanimate forms, and even the advantages of comparative anatomy may be paralleled by a study of the habits of modern savages, who exemplify a lower form of life. If the teaching of history by illustrative examples of similar cases were acted upon, we should, perhaps, find in the development of that idea the nearest possible approach to an experimental philosophy of history. The dangers to be avoided have been already indicated, and a spirit of caution is very necessary in this matter, before accepting any new and striking generalisation as law.

The difficulties and complications of the subject are very great, touching as they do on the most difficult of all problems—the origin and continuance of evil, and the difficulty of reconciling God's foreknowledge and man's free will. Such writers as Buckle dispose of these difficulties with great ease and celerity, at least to their own satisfaction; but, however we may differ from their conclusions, we may learn occasional lessons from their methods. As we, in our ignorance, know not from what direction light may arise, it is well there should be others in the field who look for it in a different quarter from ourselves; and, as the science of chemistry rose greatly out of the discoveries of alchemists, made for a very different purpose, so the earnest researches of those who seem to many fatalists, sceptics, and atheists, may, unknown to themselves, be the means of building up a science of history which shall 'assert eternal Providence and justify the ways of God to men.'

Besides the intellectual satisfaction to be derived from such a study, it may be undertaken with the higher motive of religious duty; for, in these days of scepticism, it becomes more and more incumbent on us to 'be able to give a reason for the faith that is in us.' This reminds us of one field of inquiry which has been opened in our times, and which cannot fail to have an important bearing on our subject—we allude to the history, or, as it is generally called, the science, of religion, which, perhaps, throws more light than any other department of historical knowledge on what Bunsen finely calls 'the workings of God in history.' The researches of men like him and Max Müller, full of a reverent though fearless search for the highest truth, seem to fulfil the ideal held out by Ruskin in speaking of this subject: 'It little becomes us to speak contemptuously of the religion of races to whom we owe so much, nor do I think any man of modesty or thoughtfulness will ever so speak of any religion in which God has allowed one good man to die trusting. Do not think you will ever get harm by striving to enter into the faith of others, or to sympathise in imagination with the guiding principle of their lives; believe me, it is wiser and holier, by the fire of your own faith, to kindle the ashes of expired religions than to let your soul shiver and stumble among their graves, through the gathering darkness and communicable cold.'†

It will readily be admitted that, as religion has been the governing principle of so many human lives, a study of it, even in its degraded forms, furnishes an important key to many of the difficulties which perplex the student in following the gradual revelation of truth.

Science has been called the new revelation of God to man, and if this be true of physical science, how much more does it apply here! The wise of all ages have tried to learn the lessons of history, and, through all the periods of darkness and horror through which the world has passed, there have ever been those who have held firmly to their faith in a Divine Ruler and Disposer of all. As we follow the vicissitudes of human history through long ages, and see, century after century, the same errors and crimes followed by the same punishments, the inevitable decay and fall of dynasties and nations that had reached a certain stage of corruption, the clear connection between national virtue and national greatness, the gradual emancipation of subject races, the steadily-increasing progress of freedom and civilisation, the ultimate

* Buckle's 'History of Civilisation.'

† Ruskin's 'Ethics of the Dust.'

triumph of good over evil—who, thinking of these things, can fail to exclaim with the poet: 'Who can doubt that through the ages one increasing purpose runs?'

If this feeling be so strong as to amount to an article of firm belief, is it not our duty to endeavour to trace, as far as our powers will allow, the meaning of that increasing purpose which has been working through the ages? Though a veil of blessed mystery has been hung over the future, are we not constantly enjoined to study the past? The Divine command, 'Search the Scriptures, for they testify of Me,' has received for us a wider and a grander significance, for to us all nature is a revelation of the Divine, and 'it is written,' not only in the Bible, but in the testimony of the rocks, in earth, and air, and sea—and, if we believe in the workings of God in history, surely there, in the record of His dealings with men, we shall learn even more of His Divine character, and hasten on the time when there shall be no more need to say: 'Know the Lord; for all shall know Him, from the least even unto the greatest.'

THE END.

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How Geography is Taught in Vienna.

BY CHARLES MANSFORD, B.A.,
Vice-Principal of the Westminster Training College.

A LITTLE more than a year ago the Council of the Royal Geographical Society appointed Mr. Scott Keltie to inquire into the state of geographical education in England and on the Continent, and to report upon the subject. The nature and extent of Mr. Keltie's commission were defined by precise and comprehensive instructions, drawn up by the Council of the Society, which range over the whole field of geographical instruction, from the primary school upwards. But although the primary school was to be the starting-point of the Commissioner's inquiries, his attention was to be chiefly directed to the methods and apparatus employed in the high schools and to the position assigned to the subject in the English and Continental universities. Hence it follows that in Mr. Keltie's valuable and very interesting report the primary schools are passed over with short notice, and the lessons which elementary teachers may gather from it are therefore rather incidental than direct. But these are neither few nor unimportant, and we strongly recommend all our readers to procure the report and read it for themselves. They will then see what a wide scope is given to geography in the best Continental schools, and how the teaching of it is made to yield an intellectual discipline of the very highest order. Indeed, this may be understood from a very slight outline of the treatment adopted in Austrian and German schools; and, for the sake of those who have not the opportunity of studying the report itself, we give the following sketch, which is mainly derived from Appendix K, containing the scheme adopted by the upper schools in Austria, and particularly in Vienna.

In Austria then, and throughout Germany generally, geography is treated as an experimental science; and since the elements of which it is made up are the same as those which compose any ordinary landscape, the first lesson is given in the open air. The pupils are conducted to some mountain or hill in the neighbourhood, and, under the direction of the teacher, they are made to classify all the features of the visible landscape, and catalogue them under certain definite heads. The next step is to fix roughly their relative position, and for this purpose the cardinal points in the horizon are determined by actual observation of the sun's course through the sky. The various objects in the landscape are then referred to their respective quadrants, and their general directions with respect to each other is noted. In order to fix more precisely the relative positions of the principal points, recourse is had to measurements, first by stepping, next by reference to particular units, such as foot, mile, etc. As far as possible, however, the measurements are actually made, and the results tabulated in definite units. For the longer distances the time-unit is employed, and the relative distances between towns or other points is roughly determined by a comparison of the times required to walk from point to point.

The next stage is concerned with the representation of these results on a flat surface; and, as a preparation for this, a model of the school is introduced, which is then reduced to plan, first of the same scale as the model and then on varying scales, which are compared with the actual building. From this point the method is to extend the plan until it embraces more and more of the surrounding neighbourhood, and finally includes districts which have not been visited. But this is done cautiously and gradually, and great pains are taken to prevent the map from degenerating into a mere sign which calls up no corresponding visual image in the mind. With the view of preventing this, and of enabling the pupils to keep a firm hold of the locality through the medium of the map, the chief places marked are visited, the distances and directions verified, and the principal routes actually traversed. The pupil is required to point out on the map the route by which he came to school and the path he would take in making any other excursion named. When the general idea of a map has thus been wrought into the mind, a good deal of attention is given to map-reading and the interpretation of cartographical terms and signs. One of the earliest exercises is to make an excursion to some accessible district under the direction of the teacher. Every member being furnished with a staff map of the locality, the principal roads are identified and traversed, map in hand, the geographical representations are compared with the features of the landscape to which they refer, distances are verified, and the course of the sun with respect to the line of hills and valleys is pointed out. Map problems are also set and worked out by the aid of drawings, or by sand and cardboard models, which show the district in relief. This last exercise is greatly facilitated by the accurate contour maps with which every school is furnished. Pieces of cardboard are cut out, of the shape and size of the contours, beginning with the lowest, and these being laid in successive strata, one above the other, a model of the district is built up to scale, and the result is a visual presentation of the profile of the district, which is then compared with the map. Sketch-maps in vari-coloured chalks are largely used, being drawn on paper both from the atlas and from memory. Indeed, the map is made to serve as book and picture, and no pains are spared to give the pupil such an understanding of it as shall enable him to conceive in his mind and

actually draw on paper the salient features of the district represented.

In passing to maps of unvisited countries the scale is invariably kept in view. To aid in this the comparative magnitudes of towns and districts are represented by parallelograms drawn to scale, and the map of some well-known country or district drawn to the same scale is placed beside the map in use. Furthermore, pictures and drawings are freely used to bring home to the pupil the configuration of the tract mapped, and to keep before his mind an actual landscape and the way in which it is illuminated during the course of the sun across it.

Lastly, there follows the linguistic expression of what has been learned. This, of course, accompanies every stage of the process, and affords the test as to whether that which has been perceived has been really comprehended. Here there is nothing different in method from that pursued in our own schools. What is specially characteristic of the German schools is the treatment of the map which has been indicated. When thus taught, geography becomes a mental exercise of the very highest order, and justifies the estimate which the directors put upon it when they affirm that "geography, when truly vital, holds no merely passive, but also a kind of creative or formative attitude to the features of the earth's surface, just as painting or the plastic art is in part *creation*, and not mere copying."

—o—

How I Teach Domestic Economy.

BY MRS. WIGLEY,

Author of 'Marshfield Maidens,' 'Our Home Work,' 'Workers at Home,' 'Royal Series Domestic Economy,' 'Cookery and Home Comforts,' 'The Merryweathers,' 'Thoughts,' etc.

CHAPTER IX.

ELEMENTS AND COMPOUNDS.

WITH the acquisition of such information as I laid before you in the last chapter, and with even more repetition and recapitulation of the main points, our children would begin to receive our lessons with clearness and with intelligence. Of course I know that this amount of information by no means exhausts the subject, and of course also I know that the more they learn of it the better, but I have already hinted at the reason which limits our range, and which must keep us within bounds.

We have done something, however, if our children understand no more than this:—

1. How food is reduced, so as to admit of its appropriation by every part of the body.

2. How by means of this food heat is produced, and our regular internal heat kept up.

We said in a former chapter that all thorough intelligent teachers would like the future course of Domestic Economy better than the one now passing out of use, and this because we were expected to go to the root of the matter at the beginning; in short, allowing the children to see for themselves the necessity of the things we recommended by making them acquainted with the actual need to be supplied. Let me once again condense the whole matter.

1. Food has to build up and nourish the body and to supply all daily waste.

2. Food has to supply the carbon which in consuming shall generate sufficient heat to keep up our natural warmth.

You will notice that we have not hinted at the fixed degree of natural heat necessary to health, nor to the cooling down process by means of which we lower the temperature when needed. This part of the subject we must take up at a future time in connection with clothing.

Here, then, is the condensed matter for our first year's work.

'Food—its Composition and Nutritive Value, Clothing and Washing.'

Let me remind you again that we must first show the need in the body before we turn the attention to the supply in the food.

Now there is no denying that this subject, the composition of the human body, is rather dry and deep for children no older than those we have to teach. It would be quite possible to prepare for them certain tables from the best authorities, showing the primary elements, and the almost innumerable compounds into which those elements can form themselves. And it is also quite possible that our children should get such tables by heart. The boy who was whipped every day until he knew the alphabet might well ask: 'Was it worth while to go through so much to get so little?' And I think the puzzling chemical names would really do our children—our girls, at any rate—little real good—not enough to compensate them for the suffering endured in mastering them. So that though I think we, as teachers, ought to acquire such knowledge, we must not forget that while such strong meat is good for us, we must provide milk for our babes.

I have now before me several of these tables, which I will copy out for your benefit and for my own, before we proceed to extract their condensed essence for the use of our children. I said *copy out*. I hope I may be forgiven for doing this, as in a matter like this we can have no *original* material to use; we are obliged to fall back upon the superior knowledge of those who are authorities on the subject.

The first of these tables I take from my revered teacher, Dr. Lankester. It is found in his 'Popular Physiology,' published 1872.

TABLE I.

ULTIMATE ELEMENTS OF THE HUMAN BODY.

	Lbs.	Ozs	Grns
1.—*Oxygen*, a gas which forms 1 part in every 5 of the air we breathe, and 8 parts in every 9 of the water we drink	111	0	0
2.—*Hydrogen*, a gas. The lightest body in nature	15	0	0
3.—*Carbon*, a solid.—When obtained from animals it is called animal charcoal...	21	0	0
4.—*Nitrogen*, a gas	3	9	0
5.—*Phosphorus*, a solid. This substance is inflammable, and is ordinarily kept in water...	1	12	190
6.—*Calcium*, a solid. The metallic base of lime	2	0	0
7.—*Sulphur*, a solid. A well-known substance	0	2	219
8.—*Fluorine*, a gas, found united with calcium	0	2	0
9.—*Chlorine*, a gas. When combined with sodium it forms common salt ...	0	2	382
10.—*Sodium*, a metal. It is so light that it floats on water, and is kept in naphtha to prevent its oxidation	0	2	116
11.—*Iron*, a metal. Small quantities necessary to the health of the body ...	0	0	100

	Lbs.	Ozs.	Grns.
12.—*Potassium*, a metal. Like sodium, it floats on water	0	0	290
13.—*Magnesium*, a metal; combined with oxygen, it forms magnesia	0	0	12
14.—*Silicon*, a metallic substance, which enters into the composition of the teeth and hair	0	0	2
	154	0	0

Dr. Lankester goes on to say:—'These elements, when combined together, form a set of compound bodies, out of which the tissues and fluids of the body are formed, as seen in the following table:—

TABLE II.

COMPOUNDS IN THE HUMAN BODY.

	Lbs.	Ozs.	Grns.
1.—*Water*, composed of oxygen and hydrogen gases	111	0	0
2.—*Gelatine*, of which the walls of the cells and many tissues of the body, as the skin and bones, are principally composed	15	0	0
3.—*Fat*, which constitutes the adipose tissue	12	0	0
4.—*Phosphate of Lime*, forming the principal part of the earthy matter in the bones	5	13	0
5.—*Carbonate of Lime*, also entering into the composition of the bone	1	0	0
6.—*Albumen*, found in the blood and nerves	4	3	0
7.—*Fibrin*, forming the muscles and clot and globules of the blood	4	4	0
8.—*Fluoride of Calcium*, found in the bones	0	3	0
9.—*Chloride of Sodium*, or common salt	0	3	376
10.—*Chloride of Potassium*	0	0	10
11.—*Sulphate of Soda*	0	1	170
12.—*Carbonate of Soda*...	0	1	72
13.—*Phosphate of Soda*	0	0	400
14.—*Sulphate of Potash*...	0	0	400
15.—*Peroxide of Iron*	0	0	150
16.—*Phosphate of Potash*	0	0	100
17.—*Phosphate of Magnesia*	0	0	75
18.—*Silica*	0	0	3
	154	0	0

Now in these tables we are told the elements and the compounds formed by those elements which are found in the human body. I should now like to introduce another table, showing in what parts of the body these compounds are to be looked for. I am taking this from 'Food,' by A. H. Church, M.A., published in 1880.

1. *Oxygen*—forms ⅔ of water and ⅕ of air.
2. *Carbon*—is found in the body in combination with other elements, and by its burning sets free heat.
3. *Hydrogen*—occurs mainly in water in combination with oxygen.
4. *Nitrogen*—an essential part of all bone, blood, and muscle.
5. *Phosphorus*—found in the compounds which form the bones and the brain.
6. *Sulphur*—found in the compounds which form the tissues and secretions of the body.
7. *Chlorine*—found in combination with sodium all through the body.
8. *Fluorine*—found united with calcium in the bones and teeth.
9. *Silicon*—found, united with oxygen, in the hair, bones, blood, bile, saliva, and skin.

Besides these nine non-metallic compounds, there are seven metals, as Calcium, Potassium, Sodium, Magnesium, Iron, Manganese, and Copper, which are found chiefly in the bones, the blood, and the bile. Faint traces of the two last-named are also found in the brain.

These tables show us:—

a. The elements.

b. The compounds formed by the elements.

c. The parts of the body formed by such compounds.

We will consider in the next chapter *how much* and *in what way* this information is to be imparted to our children.

(To be continued.)

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Lectures on Shakspere's 'Tempest.'

BY H. MARMADUKE HEWITT, M.A., LL.M.,
Late Assistant-Examiner in the University of London.

VIII.

FROM ACT V. SC. 1, LINE 95 TO THE END OF THE PLAY.

(The figures in brackets refer to the pages of the Clarendon Press Edition.)

So well satisfied is Prospero with the way in which his designs have been seconded by Ariel, that we find him addressing his servitor with '*There's my dainty Ariel*,' just as on an earlier occasion we find him exclaiming, '*Well, that's my spirit.*' Ariel, with characteristic energy, offers to fetch the master and boatswain in an incredibly short space of time, an idea which he expresses by the words '*Or ere* (*i.e.*, before) *your pulse beat twice.*' '*A trifle to abuse me*' means much the same as 'a phantom to deceive me.' The apparitions raised by Prospero have been already alluded to in the expression '*some vanity of mine art*,' and a little later on they are referred to as '*subtilties o' the isle.*' Very crabbed and awkward is the passage '*The affliction of my mind, with which, I fear, a madness held me.*' It probably stands for 'wherein,' or 'as to which, a delusion possessed me.' '*This must crave*,' he continues, '*a most strange story*'—that is, 'It will be necessary to give you a very curious account of our adventures.' '*An if this be at all*' is equivalent to 'If this is an actual occurrence, and not a delusion.' Observe that it is the King of Naples, and not the usurping brother, who says, '*I resign thy dukedom.*' To 'bring his highness's displeasure upon' the two traitorous noblemen is expressed by '*pluck his highness' frown upon*' them, and 'prove you traitors' appears as '*justify you traitors.*' *Rank* is a singular epithet to apply to an action, and yet it appears in another passage of Shakspere, viz., '*O, my offence is rank.*' It is easy to see what the metaphor comes from.

'*I require*,' is put for '*I demand*,' as in Luke xii. 20, 'This night thy soul shall be *required* of thee.' '*I am woe for't*,' means 'I am sorry for it,' or 'I regret it.'

Another confused construction appears in the following:

> 'You have not sought her help, of whose soft grace
> For the like loss I have her sovereign aid.'

Substitute *the* for *her* in the second line, and the meaning is pretty clear. The speaker is alluding to patience. By its sovereign aid he asserts that he is able to bear the loss of his daughter.

'*Supportable to make the dear loss*' = 'to make the sad loss bearable'; and '*have I means much weaker*' = 'I have much weaker means.'

Describing the effect of his statements, Prospero says, 'These lords *do so much admire*, that they *devour*

their reason, and scarce think their eyes *do offices of truth*.' We may paraphrase, and at the same time explain, this by writing, 'These lords are so much astonished at what they see that they lose their heads, and scarcely believe that their eyes perform their functions correctly.' After *offices of truth* some words (probably *and that*) are necessary to complete the sense.

What is the meaning of the preposition in the words '*thrust forth of Milan*'? Probably *of* is put for *by*, and by Milan is meant the Duke of Milan—that is to say, the usurping brother, Antonio. By '*a relation for a breakfast*' Prospero means, not a victim of cannibalism, but a story short enough to be told at the morning meal.

Ferdinand and Miranda are now discovered playing at chess. Miranda's protest, '*You should wrangle for a score of kingdoms*,' means pretty much, 'You might over-reach me, even were the game played for a score of kings, and I would still call it fair-play.' Having won the prize of Ferdinand's affections, Miranda is quite willing to concede every minor privilege as unimportant. Ferdinand, when confronted with his father, speaks up bravely for his betrothed, and when alluding to Prospero, speaks of him as being '*second father*' to himself, which is a poetical substitute for 'father-in-law.' *Heaviness* for 'sorrow,' and *inly* for 'inwardly,' scarcely call for comment. We must understand *found* between '*Prospero*' and '*his dukedom*,' and the expression '*when no man was his own*' is much the same as 'when no man was in his right senses,' or, in other words, 'when every one was beside himself for fear of death.'

Ariel, addressing the boatswain, says to him, 'Now, blasphemy that swear'st grace o'erboard' (64). *Blasphemy*, for 'blasphemous fellow,' is one more instance of the use of the abstract for the concrete noun which we have noticed earlier in the play, and the rest of the words may be represented by 'who by swearing dost deprive us of the mercy of heaven.' Heaven's mercy is, as it were, thrown overboard by the boatswain's profanity. Another instance of the construction we have just alluded to appears in the words 'my diligence,' which are addressed by way of commendation to Ariel. Four lines further on we have *conduct* for 'conductor,' or author. '*More than nature was ever conduct of*' means, of course, 'more than Nature ever brought about by its ordinary operations,' that is, something supernatural.

'*Do not infest your mind*,' says Prospero, meaning 'do not disturb it.' *Beating on* is 'thinking anxiously about'; '*at picked leisure*' means 'at a moment chosen when I have nothing to do'; and '*single I'll resolve you*' means 'I will answer your questions by myself.' '*Every these happened accidents*,' is a mode of writing briefly 'each and all of these events which have taken place'; and the satisfactory character of the explanation, when it comes, is indicated by the parenthetic clause, '*which to you shall seem probable*.'

Most persons will have noticed that Trinculo's expression, '*If these be true spies which I wear in my head*,' means no more than 'if my eyes are to be depended on.' Not so easy of comprehension is the statement 'one is a plain fish.' What Antonio means is that he is 'plainly a fish,' not a fish of a certain appearance. Those students who know a little Greek will at once detect a similarity between this construction and that of the word which is represented in English letters by *dēlos*.

Fletcher's 'Scornful Lady' has a passage, '*that visible beast the butler*,' which means 'the butler who is visibly (evidently) a beast.' Notice, also, that 'a true man' meant in Shakspere's time one who was not a thief, so that '*say if they be true*' is much the same as 'pronounce whether they be honest.' A very difficult line is—

'And deal in her command without her powers.'

If to '*deal to her command*' mean 'to exercise her (*i.e.*, the moon's) influence,' and '*without her power*,' mean 'without being empowered to do so,' the whole assertion is that she could multiply the phenomena of the moon's action, not by the moon's aid, but by her own potent charms. Mr. Wright prefers to interpret the last words as 'beyond her power'; but what does 'beyond her power' mean? Is it beyond the witch's power, or beyond the moon's? And, again, does power mean that which she can do, or that which she can do rightfully? No very satisfactory explanation can be possibly extracted from the words as they stand; and, if such an opinion be not 'flat blasphemy,' we would suggest that the line is merely an instance of hasty and inaccurate writing on the part of the author. *Reeling ripe* (66) is a synonym for 'drunk and ready to fall,' and *gilded* for 'intoxicated.' But why should *gilded* ever have that meaning? Well, perhaps, this is the explanation:—The alchemists' fabled 'elixir of life,' an imaginary fluid which, it was thought, could confer new life upon those who drank it, was sometimes called '*aurum potabile*,' or 'liquid gold.' The drunkards are said, jocularly, to have got some of the 'elixir of life' under their skins, inasmuch as what they have swallowed has created a temporary accession of vigour and spirits. By '*I am but a cramp*' Stephano means that he is a cramp all over. We need scarcely offer an explanation of *trim it*, *go to*, and *waste the night*; nor will it surprise any one to find the reflective form *retire me* put for 'retire' (67). '*Sail so expeditious that shall catch*' requires the introduction of the pronoun *it* between *that* and *shall*, just as in line 270 the word *she* must be inserted after *that* in '*that could control the moon*.'

We have finished our remarks on the play. There are one or two things to be noticed in the epilogue. When Prospero asks his audience to relieve him 'with the help of their good hands,' he is, of course, asking for their applause, or the manifestation of their approval by clapping their hands. The words '*unless I be relieved by prayer*' are an allusion to the old stories of the despair of necromancers in their last moments, and of the efficacy of the prayers of their friends on their behalf.

A student who is getting up this play with a view to an examination will, of course, 'post himself' very thoroughly in the date of its publication, the sources from which the author derived his materials, and such like information. It may be as well to remember that the nautical phraseology claims to be correct and accurate. Shakspere has shown a knowledge of what were then new improvements in seamanship, as well as of some doubtful points in the captain's code. 'Striking the topmasts' was a new invention at the time when this play was written, and the poet has introduced this, with considerable propriety, into the first scene. Perhaps this nautical dialogue is the first example of sailors' language being exhibited on the stage.

Chemistry of the Non-Metallics.

[This series of articles, whilst dealing with the subjects required by the University of London for the Matriculation Examination and with those required at the Elementary Stage of the Inorganic Chemistry (Branch X.) Science and Art Department, is intended as a practical guide to the philosophical and systematic study of the non-metallics.]

CHAPTER XIII.

The Oxides of Carbon. Sources of Carbon Dioxide. Carbonates. Hard Water.

E. Mixture. Gunpowder.

Compounds with oxygen.

Carbon oxide, or carbon monoxide.

a. CO. Graphic formula C=O.

b. 28.

c. First Preparation. From carbon dioxide.

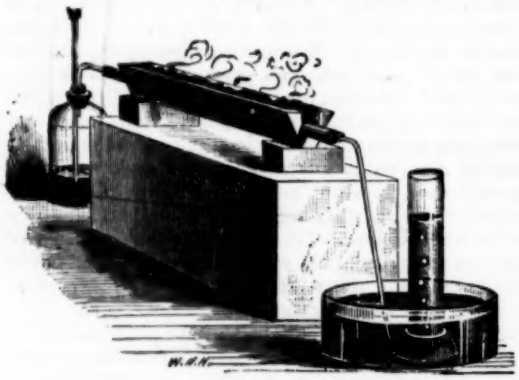


Fig. 35.

1. Arrange on a gas furnace, as in Fig. 35, a piece of iron tubing, in which is a quantity of powdered charcoal. Fit to one end of the tube a cork, through which passes the tube from an apparatus for evolving carbon dioxide, and to the other a cork with a delivery tube going to the pneumatic trough. The carbon dioxide, passing over the red-hot charcoal is reduced to the condition of carbon monoxide. This latter may be caught over water.

2. $CO^2 + C = 2\,CO$.

3. 44 + 12 = 56
   2 vols. 4 vols.

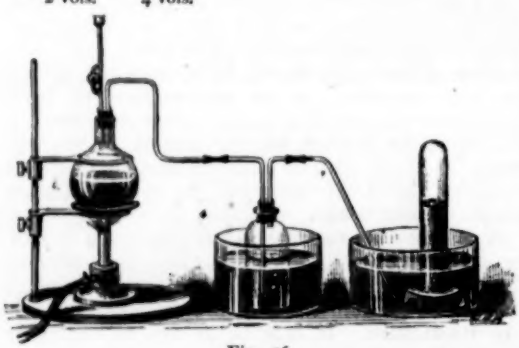


Fig. 36.

Second Preparation. From oxalic acid.

1. Arrange an apparatus like that represented in Fig. 36. In the flask to the left place oxalic acid, with concentrated sulphuric acid. In the middle flask place a solution of caustic soda. When the oxalic acid is heated, it breaks up into water (absorbed by the sulphuric acid), carbon dioxide (absorbed by the caustic soda), and carbon oxide, which passes on and can be caught, not by displacement of air, but over water.

2. $H^2C^2O^4 = H^2O + CO^2 + CO$.

3. 90 = 18 + 44 + 28.
   2 vols. 2 vols.

The carbon dioxide combines with the caustic soda to form sodium carbonate and water.

2. $NaHO + CO^2 = Na^2CO^3 + H^2O$.
   80 + 44 = 106 + 18.
   2 vols.

Third Preparation. From potassium ferrocyanide and sulphuric acid.

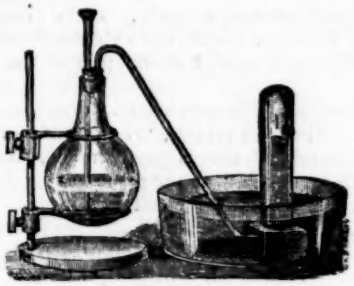


Fig. 37.

1. Powder some potassium ferrocyanide, and place it in a flask. Pour on it 10 times its weight of strong sulphuric acid. Sulphates of potassium, iron, and ammonium are formed, and carbon oxide is given off.

2. $K^4FeC_6N_6 + 6H^2SO^4 + 6H^2O = 2K^2SO^4 + FeSO^4 + 3(H^4N)^2SO^4 + 6CO$.

3. 368 + 588 + 108 = 348 + 152 + 396 + 168.
   12 vols.

d. 1. Gas; very difficult to liquefy. It used to be called a 'permanent' gas.

2. With scarcely any taste or smell. Colourless.

3. On the hydrogen scale, 14. On the air scale $\frac{14}{14{\cdot}47} = {\cdot}96$

4. Not very soluble. 100 cc. of water dissolve 2·4 of the gas at 15°.

5. Combustible, forming carbon dioxide.

$2CO + O^2 = 2CO^2$
56 + 32 = 88
4 vols. 2 vols. 4 vols.

This property of carbon oxide renders it a good reducing agent, *i.e.*, a body able to take away oxygen from a compound. In the reduction of many of the metallic ores carbon oxide plays a part. Its heat of combustion is 2403.

6. Very poisonous.

Carbon Dioxide or Carbonic Acid.

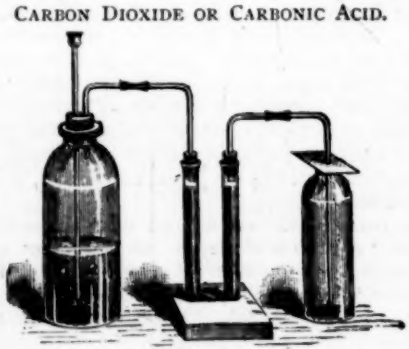


Fig. 38.

Graphic formula O=C=O

a. CO^2.

b. 44.

c. FIRST PREPARATION. From carbon oxide.

See above. The oxide can be oxidised and form the dioxide by means of copper oxide.

SECOND PREPARATION. Organic bodies, such as pieces of sugar (vegetable) or meat (animal), if heated with copper oxide, yield carbon dioxide, the oxygen of the copper oxide uniting with the carbon of the organic body.

THIRD PREPARATION. From calcium carbonate and hydrochloric acid.

1. Arrange an apparatus as in Fig. 38. In the left-hand bottle place fragments of calcium carbonate in the form of marble or chalk (not prepared chalk). The bent tube contains calcium chloride. Pour on the marble or chalk hydrochloric acid. The calcium carbonate is decomposed. Calcium chloride is formed, and remains in the bottle. Steam is formed and retained by the calcium chloride. Carbon dioxide passes on, and can be caught by displacement of air or over water.

2. $CaCO^3 + 2HCl = CaCl^2 + H^2O + CO^2$.

3. 100 + 73 = 111 + 18 + 44
2 vols.

FOURTH PREPARATION. Natural sources of carbon dioxide.

The carbon dioxide present in air, and so valuable as a food stuff of plants, is yielded by the following processes :—

α. Combustion.—Most burning bodies consist in part of carbon. Hence, when they burn or unite with oxygen, carbon dioxide is one of the products.

β. Respiration.—This is but a special case of combustion. The breathing of plants and animals is a process by which the carbon dioxide resulting from the combustion of their working tissues is eliminated.

γ. Decay.—This is but a special case of combustion. The dead plant or animal burns away slowly, its tissues combining with the oxygen of the air. Carbon dioxide is one of the chief products of such decay.

δ. Fermentation.—Every process of fermentation, *i.e.*, of the breaking up of an organic body into simpler forms under the action of a fermenting substance, such as yeast, results in the evolution of carbon dioxide.

ε. Rivers.—River-water contains a large quantity of organic things in solution or held in suspension. These are slowly oxidised when in the water itself. The water of the Thames near its mouth is very much purer than Thames water at Woolwich. Impurities have been gradually burnt off. As these impurities are compounds containing carbon, carbon dioxide is constantly given off from the surface of rivers.

ζ. Choke-damp.—The gas left in mines after explosion of fire-damp is carbon dioxide.

d. 1. A gas that can be liquefied under a pressure of 36 atmospheres.

2. Without taste, odour, colour.

3. 22 or $\frac{22}{14{\cdot}47} = 1{\cdot}5$ on the air scale.

4. Soluble in water. 100 cc. of water dissolve 180 cc. of the gas. Under pressure, water will take up more than this quantity, and this is the explanation at once of effervescent springs and of aerated water and wines. In the springs water at great depths has taken up carbon dioxide under great pressure, and on coming to the surface gives out this gas. In the wines and aerated waters the gas is pumped in under great pressure, and the cork is wired down. On the removal of the cork the gas escapes.

The contents of a seltzer-water bottle may therefore be used to demonstrate the properties of carbon dioxide.

This gas, in solution, has the remarkable property of rendering soluble calcium carbonate (marble, chalk, limestone).

In distilled water calcium carbonate is not soluble ; but in water containing carbon dioxide the calcium carbonate is soluble. Hence the spring-water mentioned above is very apt to contain calcium carbonate in solution. If it has flowed over or through limestone strata it will have dissolved some of the limestone. Then the water is 'hard.'

Water is called hard when calcium salts are present in it, because with soap such water forms an insoluble curd. Ordinary soap is a salt of the metal sodium. The sodium is combined with a fatty acid, of which the calcium salt is not soluble. When, therefore, the soap is placed in water containing, *e.g.*, calcium carbonate in solution, the two metals, sodium and calcium, change places, and the calcium salt of the fatty acid being insoluble, is thrown down as a curd.

In order to make hard water soft, when the hardness is due to calcium carbonate, we must get rid of the free carbon dioxide. That eliminated, the carbonate that it rendered soluble will be precipitated. Two methods are employed. The water is boiled. Gases are less soluble in hot than in cold water, therefore the carbon dioxide passes off. Or an alkali is added. This, combining with the acid, neutralises it, and the salt is deposited. Lime-water added to hard water will often cure the hardness, as the free carbon dioxide joins with the added lime to form calcium carbonate, and this new carbonate with that already present falls as a precipitate.

$$CaO + CO^2 = CaCO^3$$
$$56 + 44 = 100$$

The solution of carbon dioxide in water is really a compound of carbon dioxide with water called hydrogen carbonate.

$$CO^2 + H^2O = H^2CO_3$$
$$44 + 18 = 62$$

This hydrogen carbonate is the starting-point of all the carbonates. These are formed by the substitution of other metals for the hydrogen in hydrogen carbonate.

K^2CO^3 = potassium carbonate.
$NaHCO^3$ = sodium hydrogen carbonate.
$BaCO_3$ = barium carbonate.

TESTS FOR CARBONATES.

(1) $+BaCl^2$ = white precipitate. Treated with hydrochloric acid the liquid becomes clear, with effervescence of carbon dioxide.

$$K^2CO^3\ (e.g.) + BaCl^2 = BaCO^3 + 2KCl$$
$$138 + 208 = 197 + 149.$$
$$BaCO^3 + 2HCl = BaCl^2 + H^2O + CO^2$$
$$197 + 73 = 208 + 18 + 44$$
2 vol's.

(2) $+AgNO^3$ = white precipitate of silver carbonate, yielding similar results to the last if treated with hydrochloric acid.

$$K^2CO^3 (e.g.) + 2AgNO^3 = 2KNO^3 + Ag^2CO^3$$
$$138 + 340 = 202 + 276$$
$$Ag^2CO^3 + 2HCl = 2AgCl + H^2O + CO^2$$
$$276 + 73 = 287 + 18 + 44$$
2 vols.

(3) $+Pb^2(NO^3)$ = similar results to those in the last two tests.

$$K^2CO^3 (e.g.) + Pb^2NO^3 = PbCO^3 + 2KNO_3$$
$$138 + 331 = 267 + 202$$
$$PbCO_3 + 2HCl = PbCl_2 + H_2O + CO_2$$
$$267 + 73 = 278 + 18 + 44$$
2 vols.

5. Not a supporter of combustion nor combustible. Lighted bodies cannot burn, nor can living things breathe in carbon dioxide.

6. Weakly acid in its reaction.

Introduce into some carbon dioxide in a dry flask a small piece of potassium, and apply heat. The metal unites with the oxygen of the gas, and the carbon is set free.

$$CO^2 + 4K = 2K_2O + C.$$
$$44 + 156 = 188 + 12$$
2 vols.

Carbon dioxide is one of the food-stuffs of plants. The green parts of vegetables take in the gas from the air, decompose it, retain the carbon, and give out the oxygen.

Pass a stream of carbon dioxide into water. Place the solution of the gas thus made in a beaker. Immerse in it a little fresh green vegetable matter, *e.g.*, parsley. Cover this with a funnel, and invert over the funnel a test-tube filled with water.

Expose the whole to sunlight. Oxygen is given off from the vegetable matter, and collects in the test-tube. It can be tested in the usual way.

Carbon dioxide combines with lime to form calcium carbonate. Thus, a good test for this gas is lime-water. This is at once turned turbid by carbon dioxide, though a larger quantity of the latter renders the liquid clear again, as the calcium carbonate formed is redissolved by the excess of carbon dioxide. If we breathe for some time into lime-water the liquid becomes at once turbid, and later on, clears up again.

$$CaO + CO^2 = CaCO^3$$
$$56 + 44 = 100$$
2 vols.

EXERCISES ON THE OXIDES OF CARBON. (*Solved.*)

93. What volume of carbon dioxide will be converted into carbon oxide by 144 grams of carbon, the temperature being 260° and the pressure 380 mm.? What volume of carbon dioxide is formed?

mm.

12 grams C turn 22·4 litres CO^2 into 44·8 litres CO at 0° and 760

1 gram „ turns $\frac{22\cdot4}{12}$ „ „ $\frac{44\cdot8}{12}$ „ „ „

144 grams „ turn $\frac{22\cdot4\times144}{12}$ „ $\frac{44\cdot8\times144}{12}$ „ „

273 vols. at 0° become 533 at 260°

1 vol. „ becomes $\frac{533}{273}$ „

$\frac{22\cdot4\times144}{12}$ „ become $\frac{533\times22\cdot4\times144}{273\times12}$ at 260°.

Under pressure 760, vol. $= \frac{533\times22\cdot4\times144}{273\times12}$

„ „ 1, vol. $= \frac{533\times22\cdot4\times144\times760}{273\times12}$

„ „ 380, vol. $= \frac{533\times22\cdot4\times144\times760}{273\times12\times380}$

1049⅓ litres CO, and 2099⅓ litres CO^2.

94. What weight of oxalic acid must be decomposed that the volume of all the three gases given off may be, at 143°, 102·4 litres?

273 + 143 = 416 vols. at 143° become 273 at 0°

1 vol. „ becomes $\frac{273}{416}$ „

102·4 litres „ become $\frac{273\times512}{416\times5}$ at 0°.

67·2 litres of the 3 gases require 90 grams $H^2C^2O^4$

1 litre „ „ requires $\frac{90}{67\cdot2}$ „ „

$\frac{273\times512}{416\times5}$ litres „ „ require $\frac{90\times273\times512}{67\cdot2\times416\times5}$ „

= 90 grams.

95. What volume of oxygen is needed for the complete combustion of 100 cc. carbon oxide, and what volume of carbon dioxide is formed if the temperature is 250° and the pressure 800 mm.?

In this case, as only volumes of gases are concerned, the temperature and pressure, affecting them all equally, need not be considered.

4 vols. CO need 2 vols. O and form with them 4 vols. CO^2.

1 vol. „ needs ½ „ „ „ ½ „

100 vols. „ need $\frac{2\times100}{4}$ „ „ $\frac{4\times100}{4}$ „

50 cc. O and 100 cc. CO^2.

96. After treating a mass of chalk with hydrochloric acid, 777 grams of calcium chloride are left, and a kilogram of chalk. What was the original weight of the chalk?

When 111 grams $CaCl^2$ are left, 100 grams $CaCO^3$ are used.

„ 1 gram „ is „ $\frac{100}{111}$ „ „

„ 777 grams „ are „ $\frac{100\times777}{111}$ „

∴ 700 grams are decomposed, and

1,700 grams was the original weight.

97. Find the volume of water necessary to dissolve 11 grams of carbon dioxide.

44 grams CO^2 measure 22·4 litres.

1 gram „ measures $\frac{22\cdot4}{44}$ „

11 grams „ measure $\frac{22\cdot4\times11}{44}$ litres.

180 cc. CO^2 require for solution 100 cc. of water.

1 „ requires „ $\frac{100}{180}$ „ „

$\frac{22\cdot4\times11}{44}$ „ require „ $\frac{100\times22\cdot4\times11}{180\times44}$ cc. of water

= 3⅓ cc.

98. Find the percentage composition of acid potassium carbonate.

$KHCO^3 = 39 + 1 + 12 + 48 = 100$

∴ the percentage composition is

39 of K, 1 of H, 12 of C, 48 of O.

EXAMPLES ON THE OXIDES OF CARBON. (*For solution.*)

87. 60 grams of carbon are used for the conversion of carbon dioxide into carbon oxide. Find the volume of carbon dioxide used, and of the carbon oxide formed, reduced to normal temperature and pressure .....112 litres CO^2, 224 litres CO.

88. 450 grams of oxalic acid are decomposed by heat. What weight of caustic soda is required to absorb the carbon dioxide that is formed? .....400 grams.

89. 7 grams of carbon oxide are burnt. To what temperature must 168·21 grams of water, originally at 100°, be cooled, that they may give out as many heat-units as are evolved in the burning of the carbon oxide? .....0°.

90. Find the heat-units given out in the burning of 6 grams of carbon and absorbed in the reduction of the carbon dioxide that is formed to the condition of carbon oxide.

48,480. 67,284.

91. The percentage composition of barium carbonate?

Ba $69\frac{137}{197}$, C $6\frac{12}{197}$, O $24\frac{48}{197}$.

92. What weight of barium nitrate is needed for the complete precipitation of 276 grams potassium carbonate? ...522 grams.

93. How much ammonium carbonate could be precipitated by 26 grams of barium chloride? .....12 grams.

94. What weight of carbon dioxide will be dissolved by a litre of water at 0°? .....$3\frac{1}{11}$ grams.

95. What volume of carbon dioxide, at 13° and under pressure 779 mm., is necessary to precipitate 28 grams of lime dissolved in water? .....$11\frac{11}{139}$ litres.

56. Find the volume of carbon dioxide that can be driven off from a kilog. of chalk, at temperature 273°, pressure normal.

448 litres.

(To be continued.)

—c—

Lessons in Latin.

BY THE REV. A. D. CAPEL, M.A., CANTAB.,

Formerly Examiner of Schools to Cambridge Local Examination Syndicate.

(*Continued from page* 345.)

KEY TO EXERCISES.

EXERCISE 60.

A.

1. This happens to a wise man alone, that he does nothing unwillingly. 2. He has come to-day to look about; yesterday he came to conquer. 3. On the next day the king ordered all men to go out armed. 4. No one is so fierce that he cannot grow tame, provided only he lend a patient ear to instruction. 5. It is not always in the physician (*i.e.*, in the

power of the physician) that the sick man should be relieved. 6. Sometimes put joys between thy care, that you may be able to bear any labour with your mind. 7. That nothing may be wanting to you, use sparingly what you have sought (and got); and that you may keep what you have, always think that it is wanting to you. 8. I fear you have undertaken (this) labour in vain. 9. Flatterers, if they praise anybody, say they fear that their deeds cannot imitate their words. 10. Why do I not send my little books to you, O Pontilianus? That you may not send me yours, O Pontilianus.

B.

1. Edimus ut vivamus, non vivimus ut edamus. 2. Themistocles persuasit populo ut classis ædificaretur. 3. Pylades Oresten se esse dixit, ut pro illo necaretur. 4. Pompeium monere non desistimus ut infamiam fugiat. 5. Relinquamus amicis mærorem, ut celebrent funera cum gemitu. 6. Impedit ira animum, ne possit cernere verum. 7. Cura ne denuo in morbum incidas. 8. Tum forte ægrotabam, ut ad nuptias tuas venire non possem. 9. Vereor ut mature veniat. 10. Metuo ne, dum minuere velim laborem, augeam.

Exercise 61.

A.

1. True love can fear no one. 2. He hurts the good whoever has spared the bad. 3. It is an honest death to die for a good cause. 4. He ought to fear many whom many fear. 5. There is no soft way from the earth to the stars. 6. God looks upon pure, not full, hands. 7. Admonish your friend, secretly, praise them openly. 8. You may expect from another what you have done for the other. 9. He who repents that he has sinned is almost innocent. 10. A good opinion of men is safer than money.

B.

1. Ex vitio alterius sapiens emendat suum. 2. Imperium habere vis magnum? impera tibi. 3. Bis dat qui cito dat. 4. Remedium frustra est contra fulmen quærere. 5. Timidus vocat se cautum, parcum sordidus. 6. Levis est dolor, qui capere consilium potest. 7. Pejora juvenes facile præcepta audiunt. 8. Optanda mors est, sine metu mortis mori. 9. Fortuna nimium quem fovit stultum facit. 10. Meminisse dulce est quæ fuit durum pati.

Exercise 62.

A.

1. I had perished unless you had hastened to (me). 2. The people would pull down the images of Piso unless they had been protected by the order of the chief. 3. If men are well, your art, O Phœbus, lies (dead). 4. He could have despised the swords of Antonius if he had said all things thus. 5. All things of short duration ought to be tolerable, even if they be great. 6. That truth, though it is not pleasant, is nevertheless pleasing to me. 7. Clodius would never have left the assembly, unless he were hastening to a planned crime. 8. And if you had not hurt him in some way, you would have died. 9. Though we are held by (that is, convicted of) a fault, we have been freed from (that is, acquitted) the crime. 10. You ought to respect this man in the place of a father, if there were any piety in you.

B.

1. Pons sublicius iter pæne hostibus dedit, nisi unus vir fuisset Horatius Cocles. 2. Nemo saltat sobrius, nisi forte insanit. 3. Si vales, bene est. 4. Si quod erat grande vas, læti afferebant. 5. Non si plura velim, tu dare deneges. 6. Si foret in terris, rideret Democritus. 7. Si id scissem, nunquam huc tulissem pedem. 8. Si Atheniensis esses, clarus nunquam fuisses. 9. Etiamsi non is esset Cæsar qui est tamen ornandus videretur. 10. Si unquam visus tibi sum fortis, certe me in illa causa admiratus esses.

Examination Questions.

No. 6.

1. The neuter of the nominative case singular. 2. 'Ne lude' is a particular command; 'ne luderis (misprint for 'luseris'), expresses the command in a milder form. 3. When an author relates the speeches or writings of others, not as the speakers or writers delivered them, but in a series of oblique constructions, dependent on his own statement that they so spoke or wrote, such writing is called indirect narration. The verbs of the dependent clauses are in the subjunctive mood. 4. 'Num' expects a negative answer. 'An' properly signifies 'or,' and introduces the second and following members of double, triple, etc., questions. When it seems to introduce a single interrogation, it really refers to a previous question conceived in the mind; hence it confirms a statement by exhibiting the inadmissibility of the opposite notion. 5. By splitting up the expression 'I hurt you' into 'I apply something painful to you,' the direct object is easily discovered to be 'something painful,' which is the cognate accusative of the verb, and 'you' is the indirect object; similarly, in 'I persuade you' 'I apply a persuasion to you.' 6. 'Quo' is equal to 'ut eo,' and is used when there is a comparative in the dependent clause. 7. After verbs of hindering, preventing, etc. 8. A final clause is one which expresses the purpose for which the principal clause takes place, and if there be a 'not' in the final clause, it is joined with the 'ut,' in the form of 'ne.' A consequent clause is one which expresses what arises from the principal clause, but in this, if a 'not' appear, it is not joined with the 'ut.' A conditional clause is one which expresses the condition, or protasis, on which the principal clause, or apodosis, becomes a proposition. 9. See 8. 10. 'I came' is the perfect definite, and is followed by imperfect or pluperfect subjunctive; whereas 'I have (or am) come' is perfect definite, and is followed by the present or perfect subjunctive.

LESSON LXIII.

Relative with Subjunctive.

509. Before entering on this difficult subject we must repeat what we said in par. 208, viz., that a relative pronoun is really a conjunction (et, ut, etc.) and a demonstrative pronoun.

510. When a demonstrative (adverb or adjective, as *sic, ita, talis, is,* in sense of 'such,' etc.) has gone before, and the relative contains, as one of its constituent parts, the conjunction 'ut' (= so that), the subjunctive must be used in the relative clause, as 'Multæ res sunt *ejusmodi, quarum* (= ut earum), exitus nemo providere possit:' 'Many things are of such a kind *that* no one can foresee *their* results.'

511. Even when no demonstrative precedes, the relative may take a subjunctive—if a demonstrative be implied—and the relative may often be translated into English by 'such,' as 'Multi vulnerati, etiam *quos* vires sanguisque *desererent*, ut intra vallum hostium caderent nitebantur:' 'Many (of the) wounded, even *such* as strength and blood had deserted, were striving to fall within the rampart of the enemy.'

512. If the relative be equivalent to 'quanquam (although) is,' it is followed by a subjunctive. (See sentence 6 in first part of Exercise.)

513. 'Quod' is often equivalent to 'as far as,' and then always followed by subjunctive, as 'quod sciam,' 'as far as I know;' but quantum, when used in same sense, is followed by an indicative, as 'quantum ego intelligo,' 'as far as I understand.'

514. 'Quis sum,' used for 'num talis sum ut,' am I such a one who' is followed by a subjunctive. (See sentence 7 in first part of Exercise.)

515. Relative adverbs (see par. 404), when equivalent to demonstratives with 'ut,' also require a subjunctive. (See sentence 8 in first and second part of Exercise.)

516. The subjunctive is used after comparatives with 'quam qui' in all its cases. (See sentence 9 in first and second part of Exercise.)

517. VOCABULARY 63.

English.	*Latin.*		*Derivatives.*
False	falsus -a -um	R. fals	
To add	adjungĕre	P. R. adjunx	3rd R. adjunct
To be accustomed	consuescĕre	P. R. consuev (usually consu)	3rd R. consuet
To advise, literally / To anticipate	praecipĕre	P. R. praecep	3rd R. praecept
Temperance	temperantia	G. temperantiae	
To go before	antegredi, dep.		3rd R. antegress
Honesty	hŏnestas	G. honestātis	
To issue	excēdĕre	P. R. excess	3rd R. excess
Former	sŭpĕrior	G. superiōris	Comp. of superus
To keep in	continĕre	P. R. continu	3rd R. content
Wicked	nefas, indecl.		
To present	dōnāre	R. don	donation
To take	sūmĕre	P. R. sumps	3rd R. sumpt
Punishment	merces	G. mercēdis	(See 49)
To understand	intelligĕre	P. R. intellex	3rd R. intellect
As	ut, conj.		
To trust	crēdĕre	P. R. credĭd	3rd R. credit
Consul	consul	G. consŭlis	consular
Majority (the)	pleriquae, pleræque, pleraque, (like plu, of plerus, with que added)		
To think	arbitrāri, dep.		3rd R. arbitrat
To put to death	interfĭcĕre	P. R. interfēc	3rd R. interfect
Some one, or thing	aliquis -qua -quid, decl., like quis		
Matter	res	G. rei	E. decl.
Such	talis n. -le	G. talis	
As—and such	relative to talis, qualis, n. -le		
Innocence	innocentia	G. innocentiae	
Disposition	affectio	G. affectionis	
To find fault	quĕri, dep.		3rd R. quest
To hesitate	dubitāre	R. dubit	
To obey	pārēre, dat.	P. R. paru	3rd R. parīt
A decree	dēcrētum	G. decreti	
Catiline	Catilina	G. Catilinae	
To keep from	revocare	R. revoc	
Baseness	turpitūdo	G. turpitudĭnis	
Propriety	ratio	G. ratiōnis	
Madness	furor	G. furōris	fury
Offence	fraus	G. fraudis	fraud
To aim at	pĕtĕre	P. R. petī	3rd R. petit
So great	tantus -ta -tum, usually followed by quantus		
Faith	fides	G. fidei	
Freedom / Liberty	libertas	G. libertātis	

518. EXERCISE 63.

A.

1. Non sumus (38) ii (37) quibus (27) nihil (31) verum (29) esse (38) videatur (57), sed (6) ii qui omnibus (29) veris (29) falsa quaedam adjuncta esse dicamus (62). 2. Denique (40) te (35) noli (53) oblivisci (46) Ciceronem (1) esse, et eum qui aliis (31) consueris praecipere. 3. Qui potest (50) temperantiam laudare (2) is, qui summum (41) bonum (15) in voluptate (49) ponat (29)? 4. Quidquid (61) id est quod deceat (48), id tum (20) apparet (16) cum (20) antegressa est honestas. 5. Res (13) parva (20) dictu (Eng., 'in the saying') sed (6) quae studiis (58) in magnum (20) certamen (28) excesserit. 6. Cicero (1), qui per (3) omnes (29) superiores dies (8) milites (6) in castra (37) continuisset, septimo (47) die (8) cohortes (44) frumentatum (Eng., 'to forage') misit (43). 7. Quis (30) sum, cujus (27) aures (50) laedi (4) nefas sit. 8. Artaxerxes Lampsacum urbem (7) Thucydidi donaverat, unde (51) vinum (7) sumeret. 9. Major (49) sum quam (48) cui (27) possit (50) fortuna (40) nocere (50). 10. Data (62) merces est erroris (46) mei (20) magna (20), ut me (35) non solum (45) pigeat (48) stultitiae (46) meae, sed etiam pudeat (48), qui non intellexerim, quibus, ut amicis, (5) crederem.

B.

1. I am not such (Lat., 'is') a consul who, as the majority, thinks (it) to be wrong (that) Gracchus should be put-to-death (pres.). 2. Now (27) you say (62) something which (27) bears-on (Lat., 'pertinere ad') the matter. 3. I am not one (Lat., 'is') who says (62) (that) whatever seems (51) is such as it seems (51). 4. Innocence is such a disposition of the mind (45) that (rel.) it hurts (50) no-one (17). 5. What (30) is (there) which you can (50) find-fault with (Lat., 'cum') fortune (40)? 6. You have (7) such (Lat., 'is') a consul who does not hesitate to obey your (33) decrees. 7. You are (38) not such (or, one), O Catiline, that either (53) shame (53) has kept you from baseness, or fear (60) from danger (55), or propriety from madness. 8. What (30) did my offence aim at, except (46) that by it I might be joined (41) to you (35) alone (use 'unus'). 9. I am greater (49) than one who can be (38) a slave (7) to my (20) body (15). 10. Nothing (31) was of so great (value) that we should sell (10) for it our (39) faith and freedom.

LESSON LXIV.

RELATIVE WITH SUBJUNCTIVE (*continued*).

519. With indefinite general expressions (both affirmative and negative) the relative, introducing the circumstance that characterises the class, takes the subjunctive. (See sentence 1 in A and B of Exercise.)

520. The important word in the above clause is 'indefinite.' If there be anything which fixes the verb to a definite person, the indicative is found.

521. General negatives, nemo, nullus, or even vix-ullus (scarcely any one), etc., take the relative, followed by the subjunctive.

522. Interrogative expressions implying a negative, 'quis est,' 'quod est,' etc., and similar phrases, are followed by 'qui' with the subjunctive.

523. When the proposition introduced by the relative contains the reason of what goes before, the subjunctive is used. (See sentence 6 in first part of Exercise.)

524. When the proposition introduced by the relative expresses the end and motive of the action, so that 'qui' is = 'ut is,' and not 'que is,' the relative is followed by the subjunctive.

525. After the adjectives dignus, indignus, aptus, and idoneus, the relative with the subjunctive is commonly used; sometimes, in poetry, we find the infinitive.

526. Unus and solus when joined with 'qui' intro-

ducing the definition of the quality which the adjective limits to a single person, require a subjunctive. (See sentence 9 in both parts of Exercise.)

527. Lastly, the subjunctive is used in a narrative, after relative pronouns, when a repeated action is spoken of. (See sentence 10 in both parts of Exercise.)

528. VOCABULARY 64.

English.	*Latin.*		*Derivatives.*
To sacrifice / To pour forth freely	prōfundere	P. R. profūd	3rd R. profūs
Secession / Separation	discessio	G. discessionis	
Adversary	adversarius	G. adversarii	
Happy	felix	G. felīcis	felicitous
What in number	quotus -ta -tum	R. quot	
What a few	quotus quisque (both declined)		
To prefer	praeponere	P. R. praeposu	3rd R. praeposit
So greatly	tanto ŏpĕre, or one word, tantopere		
To move	commŏvēre	P. R. commōv	3rd R. commōt
Ardour	ardor	G. ardōris	
To think	censēre	P. R. censu	3rd R. cens
Dust	pulvis	G. pulveris	pulverise
A certain person or thing	quidam, quaedam, quiddam, decl. like qui, with 'dam appended		
Attentive	attentus -ta -tum	R. attent	
To seize	ē ripĕre	2nd R. eripu	3rd R. erept
To bestow	largīri		3rd R. largīt
To look back	respi·ĕre	P. R. respex	3rd R. respect
To fall	cădĕre	P. R. cĕcid	3rd R. cās
Whosoever / Whatsoever	qui..unque, quaecunque, quodcunque, declined like qui, with 'cunque' appended		
Lictor	lictor	G. lictoris	
To catch	prehendĕre	P. R. prehend	3rd R. prehens
To die / To fall down	occidĕre	P. R. occid	3rd R. occās
Together	una, adv., really abl. of unus		
Impiety	impietas	G. impietātis	
Shield	scūtum	G. scuti	
Dart	spīcŭlum	G. spiculi	
Perforate (to)	perfŏrāre	R. perfor	
To hate	odisse, perf., used as pres., no pres. root		
Wanton	prŏtervus-va-vum	R. proterv	
Wonderful	mirĭficus -ca-cum	R. mirific	
Wakefulness	vigilantia	G. vigilantiae	
Consulship	consŭlātus	G. consulātūs	
Fortunate	fortūnātus-ta-tum	R. fortunat	
Herald	praeco	G. praecōnis	
To serve in the army	mīlitāre	R. milit	militant
Safety	sālus	G. salūtis	salutary
To advance	eniti, dep.	3rd R. enĭ- & enīx	
To strive	niti, dep.	3rd R. nīs & nīx	
To obtain	pĕtīri, dep.	3rd R. petit, gov. abl.	
Highest point	summa	G. summae	

EXERCISE 64.

A.

1. Inventi sunt (28) multi (20) qui non modo (45) pecuniam (45) sed (6) vitam (11) etiam profundere pro (28) patriâ (10) parati essent (52). 2. Nemo (17) est qui nesciat (48), quominus (58) discessio fieret (15), per (3) adversarios tuos (20) esse factum (11). 3. Non est quod invideas (57) istis (40), quos magnos (20) felicesque populus (16) vocat (11). 4. Quotus enim (54) quisque est cui (27) sapientia (6) omnibus (29) divitiis (39) præponenda videatur (51)? 5. Quid (30) est quod (27) tanto-opere te (35) commoveat tuus (20) dolor (39). 6. Quem (30) ardorem studii (58) censetis fuisse (38) in Archimede, qui (27) dum (21) in pulvere quædam describit attentius, ne (46) patriam (10) quidem (46) captam (26) esse senserit (39)? 7. Sunt autem (38) multi (20) qui eripiunt aliis (31) quod aliis largiantur. 8. Voluptas (49) non est digna (56) ad quam sapiens (49) respiciat. 9. Solus (60) es (38) Cæsar cujus (27) in victoria (37) ceciderit nemo (17) nisi (43) armatus (2). 10. Quemcunque lictor prehendisset, tribunus (17) mitti (43) jubebat (29).

B.

1. (There) are (38) (some) who (27) think (that) the soul (54) and body (15) die together. 2. There is nothing (31) which makes (43) (men) so (58) miserable (28) as impiety. 3. There was scarcely (39) any (31) shield which many (use proper case of 'plus') darts had not perforated at the same time (40). 4. Who (30) is there who does not hate a wanton youth (44, abstract)? 5. Caninius was (so) wakeful (translate 'of such wonderful wakefulness,' abl. case) that he (use relative) did not see (27) sleep (37) (in) the whole (31) of his (20) consulship. 6. O fortunate youth (41) that you (use relative) found (28) a Homer as the herald of your (20) valour (26)! 7. Eight thousand (44) slaves (7) were bought (28) by (39) the masters (9) to (that they might) serve-in-the-army. 8. The fables (44) of Livy (use adj. 'Livianus') are not sufficiently (46) worthy (56) that they should be read (6) a-second-time ('iterum'). 9. You will be the one (31) by whom the safety of the State (14) advances. 10. They were always (33) held (use 'habere') the bravest (51) who obtained the highest point of power (19).

LESSON LXV.

SUPINES IN 'UM' AND 'U.'

530. The supines in 'um' and 'u' are formed by adding 'um' and 'u' to the third root, as: Amāre, 3rd root, amat; supines, act. amatum, pass. amatu.

531. The supines are really the accusative and ablative of a verbal noun of the fourth, or 'U' declension.

532. The supine in 'um' governs the same case as the verb governs.

533. The supine in 'um' is used with verbs which express motion to a place, *e.g.*, 'cubitum ire,' 'to go to bed,' or, more strictly, 'to set about going to bed.'

534. The supine in 'u' limits the undeclined substantives 'fas,' 'nefas,' 'opus,' and adjectives which signify good or evil, pleasantness or unpleasantness, fitness or unfitness, etc.; and, *e.g.*, 'dictu' may be translated by 'to be said,' or 'for saying,' or 'in saying.'

535. VOCABULARY 65.

English.	*Latin.*		*Derivatives.*
Philip	Philippus		Philippic
Pausanias	Pausanias	G. Pausaniæ	A decl.
Theatre	theātrum	G. theātri	theatrical
To play	lūdĕre	P. R. lūs	3rd R. lūs
Treaty	fœdus	G. fœdĕris	federal
To seek restitution	res repĕtĕre	P. R. -peti	3rd R. -petit
Crime	flāgĭtium	G. flagitii	flagitious
To disgrace	dēdĕcŏrāre	R. dedecor	
Disgraceful	turpis -pe	I decl.	turpitude
To destroy	perdĕre	P. R. perdid	3rd R. perdit
To spy	spĕcŭlāre	R. specul	speculation
To live in exile	exsulāre	R. exsul	
To draw together	contrāhĕre	P. R. contrax	3rd R. contract
From every side	undique, adv.		
To lead	dūcĕre	P. R. dux	3rd R. duct
To winter	hiĕmāre	R. hiem	
To enquire	sciscĭtāre	R. sciscit	
Necessary	opus, indecl. used with sum, followed by abl.		
To appease	plācāre	R. plac	implacable
Sweet	suavis,	N. -le	suavity
Terrible	terribilis,	N. -e	
Faithful	fĭdus -da -dum	R. fid	
Customary	ūsĭtātus -ta -tum	R. usitāt	
Kinswoman	prŏpinqua	G. -quæ	(Fem. of propinquus)
To settle	collŏcāre	R. colloc	
To know	cognoscĕre	P. R. cognōv	3rd R. cognīt
Weighty	grăvis,	N. -ve	gravity
Base	fœdus -da -dum	R. fœd	
To advance	prŏcēdĕre	P. R. process	3rd R. process
Example	exemplar, n.	G. exemplāris	exemplary
To seek	pĕtĕre	P. R. peti	petit

A.

536. EXERCISE 65.

1. Philippus a Pausania quum (13) spectatum (50) ludos (23) iret (56) juxta (9) theatrum occisus est (30). 2. Lusum it (56) Mæcenas, dormitum (17) ego (35) Virgiliusque. 3. Legati (41) a Roma venerunt (19) questum (54) injurias (51) et ex fœdere res

repetitum. 4. Ubi (49) se (35) flagitiis dedecora-verunt turpissimi viri (18) bonorum (20) prœmia (49) ereptum (64) eunt. 5. Dumnorix propinquas suas (20) nuptum (57) in alias (31) civitates (14) collocavit. 6. Quia (30) est tam (58) jucundum (21) cognitu atque (33) auditu (4) quam (48) sapientibus (49) sententiis gravibusque verbis ornata (20) oratio? 7. Quod factu (43) fœdum est, idem (37) est et dictu (62) turpe. 8. Narratio (49) brevis (49) erit (38), si (15) non longius (49), quam (48) quod (27) scitu (14) opus est in narrando (58) procedetur. 9. Ad (10) imitandum (45) tam (58) mihi (32) propositum (50) exemplar illud (37) est quam (48) tibi (37). 10. Sapiens (49) vitatu (33) quidque (Eng. 'as to what') petitu sit melius (49), causas (37) reddet tibi (35).

B.

1. Why (33) do you go (56) to destroy thyself (35)? 2. The soldiers (6) were sent (43) to spy out the citadel (57). 3. Coriolanus departed (56) to live-in-exile among (Lat. 'in,' with acc.) the Volsci (pl. noun, of 'O' decl.). 4. Cæsar, having drawn together his forces (46) from every side, led his (20) army (19) into the territories (54) of the Aedui to winter. 5. Fabius Pictor was sent (43) to Delphi (pl., 'O' decl.) to (10) the oracles (54), to inquire what (30) prayers (35) were necessary for (use, 'ad') appeasing the gods (27). 6. Many (things) (use 'plerusque') are easier (29) in saying (62) than (48) in fact (Lat., 'res') (that is, in doing). 7. What (27) will seem (51) the best (49) to be done (43), you will do. 8. Nothing (31) is sweeter in the hearing (4) than (48) the counsels (40) of faithful friends (5). 9. Many (things) (20) which were terrible to be seen (27), (when) told (58) after (17) a long (49) time (use plur.), delight (7) the minds (54) of the hearers (4). 10. Let us seek (9) what is best (49) to be done (43), not what (30) is most customary.

(To be continued.)

How to Teach Drawing in Elementary Schools.

BY T. R. ABLETT,
Superintendent of Drawing to the School Board for London.

DRAWING FROM MODELS.—IV. CURVES.

IN dealing with the model drawing of curves the drawing of the circle may be taken first. The circle seen obliquely always appears to be a true ellipse. Some teachers of drawing contend that this is not the case, because the diameter of the circle appears to be less

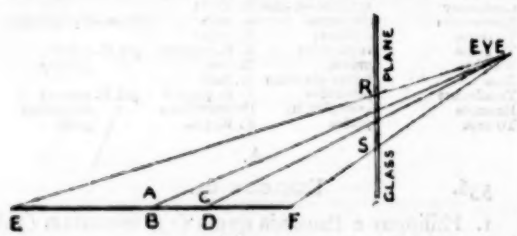


Fig. 1.

in length than a certain chord in it, but their opinion is directly opposed to well-known principles of mathematics. Fig. 1 shows a side elevation of the position of the eye, the glass plane (picture plane), a circle, and the rays of light passing from the points EABCDF in the circle to the eye and through the glass plane.

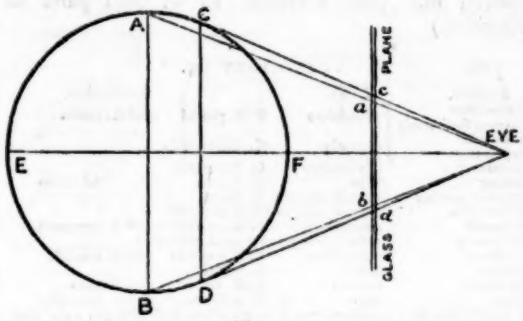


Fig. 2.

In Fig. 2, a plan of the lines shown in Fig 1 is given. From the latter it will be seen that the rays passing from the ends of the diameter AB have the distance *ab* between them on the glass plane, whilst the rays passing from CD have a greater distance *cd* between them. The diameter of the circle AB therefore appears to the eye less than the chord drawn between the tangents which pass through the points CD. The line CD is the major axis of the ellipse which represents the circle, and CFD is represented by one half of the ellipse, and CED by the other half of the ellipse. The rays of light passing from all points of the circle to the eye form an oblique cone. Its side elevation is shown in Fig. 1. The glass plane cuts a section through this cone in the line RS. Mathematicians tell us that any section of such a cone which is not cut parallel to its axis or its side is an ellipse. The section is shown by the tracing on the glass plane which accurately represents the circle.

In teaching a class to draw a circle as it appears, it is desirable to work from a big one. If there is a square black-board in the school describe a circle on it as large as it will hold. If the black-boards are all oblong draw a line so as to divide the board into a square and a long narrow oblong. Describe a circle in the square with a thick line.

The pupils have already had practice in drawing the black-board. When they have made an accurate representation of it let them draw the circle in it. Tell them the circle must be represented by a true ellipse, and point out that it will pass through the points ABCD, but that its major axis will not pass through X,

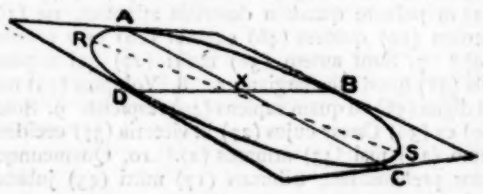


Fig. 3.

but be on the nearer side of it. It is very important to explain that the position of the major axis RS will be at right angles to the line which passes from each pupil's eye to point X. The position of RS may be

found out by holding the pencil on the imaginary glass plane supposed to be placed between the eye and the object.

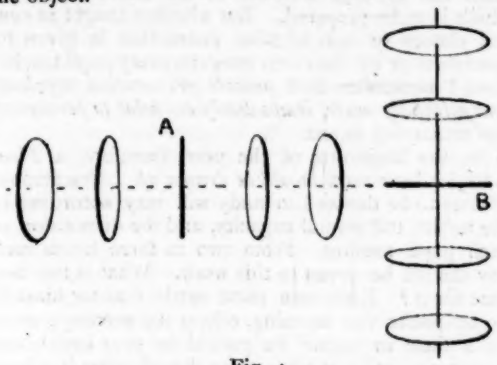


Fig. 4.

In Fig. 4, the dotted line represents the eye level. A and B represent discs placed vertically and horizontally directly opposite the eye. They appear to be lines. Discs above and below the eye level and in a horizontal position are shown joined together with disc B by a rod. A useful model may be made by fastening in a similar way a number of discs of cardboard one above another on a stick which has a square section. The model may be placed either as at B or as at A. In either position good practice can be obtained. It is want of such practice that leads to the mistakes made in drawing the two ends of the cylinder, the mouth and base of a vase, the hoops of a barrel, etc.

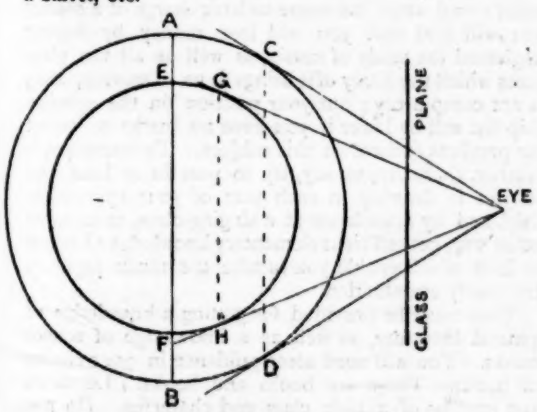


Fig. 5.

Fig. 5 is a plan showing two concentric circles. It will be noticed that the chord CD, which forms the major axis of the ellipse that will represent the larger circle, occupies a different position to the chord GH, which forms the major axis of the ellipse that will represent the smaller circle. Fig. 6 gives the perspective or model drawing of two concentric circles. The major axis of the smaller ellipse appears nearer the true centre of the circle than the major axis of the larger ellipse, as in Fig. 5. Notice that the distances AC and DB are equal to one another, and greater than GH. Also notice that GH is greater than EF. The mouth of the broad red vase which is supplied to schools as a model, is often wrongly drawn, because attention is not called to these differences between the real and apparent form of concentric circles.

If a smaller circle, concentric with the discs shown in Fig. 4, be drawn on them, good practice can be obtained in working out this principle, shown in Figs. 5 and 6 at different heights in relation to the eye. It

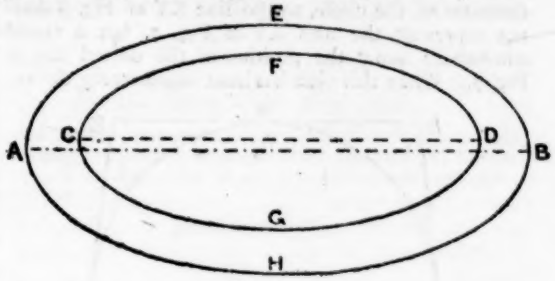


Fig. 6.

would be better still to draw circles on a black-board, as described for Fig. 3, and to place the board at a different height in relation to the eye each time the circles are drawn. The circles may be seen above the level of the eye if the board is inverted and placed on the top of two easels, put sufficiently near together for the purpose.

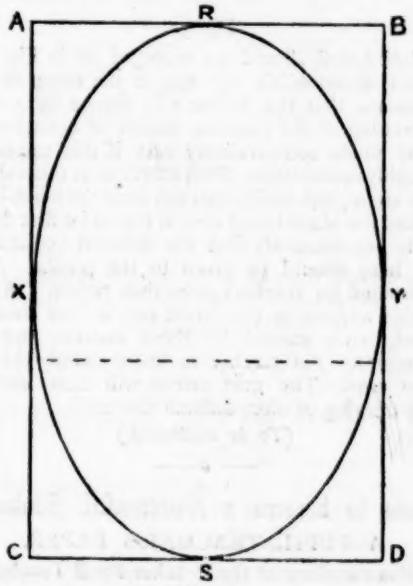


Fig. 7.

Fig. 7 shows an ellipse drawn to fill a blackboard. The outline of the board and the ellipse should first of all be drawn as a freehand copy. Then a drawing of the black board and ellipse should be made when

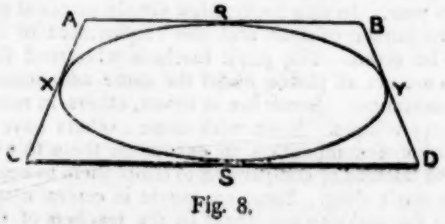


Fig. 8.

the black-board is placed horizontally not much below the level of the eye. They will appear something like

Fig. 8 if RS runs towards the spectator's eye. Notice that the axis XY, which is really the shorter, appears as the longer. As in the case of the circle in Fig. 2, where the axis of the ellipse did not represent the diameter of the circle, so the line XY of Fig. 8 does not represent the axis XY of Fig. 7, but a chord somewhere about the position of the dotted line in Fig. 7. When this view has been satisfactorily drawn,

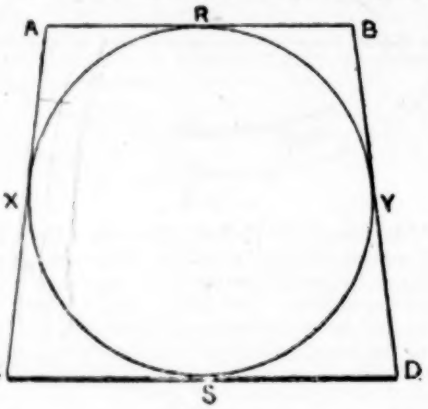


Fig. 9.

the black-board should be arranged as in Fig. 9, so that the distance XY will appear the same as RS; that means that the ellipse will appear as a circle. The drawing of the elliptical mouth of a coal-scuttle will be made comparatively easy if this exercise is thoroughly appreciated. Such exercises as these should not be attempted until pupils can draw the black-board well, and the black-board should always be first drawn.

It is not necessary that the detailed explanations given here should be given to the pupils. They are intended for teachers more than pupils. A considerable amount of discussion has, at one time and another, been caused by these matters, and it is necessary for the teacher to know exactly the facts of the case. The next article will deal with the model drawing of more difficult curves.

(To be continued.)

How to become a Successful Student.

A PUPIL TEACHER'S PAPER.

THE Examinations of the October Pupil Teachers are now past, and preparations will at once be made for the work of another year. In some cases new text-books will have to be selected, and in all cases new time-tables will have to be made out. The work of the coming year will, to each pupil teacher, be either more extended or more difficult than that of the previous year. In this paper a few simple practical rules for the pursuit of study and the employment of time will be given. The pupil teachers who read these lines are not all placed under the same advantageous circumstances. Some live in towns, others in remote country villages. Some work alone; others have the stimulus of competition to encourage them to work, or the laziness of companions to tempt them to neglect each day's duty. Some are taught in central classes, while the majority are taught by the teachers of their own schools. The practice of the head teachers in different schools as regards their pupil teachers varies. Set tasks are given to be prepared each night by many, while industrious, conscientious pupil teachers are often left to their own will in the amount of work which is to be prepared. But whether taught in central classes or not, whether instruction is given by specialists or by their own masters, every pupil teacher should remember that *private preparation, regularly and faithfully made, is absolutely essential to permanent and unvarying success.*

At the beginning of the year, therefore, a *Time-table for home work should be drawn up.* The amount of time to be devoted to study will vary according to the habits, the mental capacity, and the disposition of each pupil teacher. From two to three hours each day should be given to this work. What is the best time for it? Each one must settle that for himself. Some prefer the morning, others the evening; some do a little in both. Be guided by your health and circumstances; but when once the selection has been made, do not let a little thing divert you from your set task. Many temptations will come to you to neglect or put off your work, and the firm resistance to such temptations will be a good mental and moral discipline, and of great use to you in after life.

What subjects should the time-table embrace? No pupil teacher should be content with the bare work of the code. Wherever it is possible the *optional*, as well as the *obligatory* subjects should be taken. Supposing you have made choice of teaching as a profession, and mean to stick to it, you will find that the optional subjects are necessary to success in life. Music, for example, is not obligatory; but if you do not take it you cannot teach children to sing from notes; and when you come to have charge of a school you will find that you will lose money by having neglected the study of music, as well as all the pleasures which the study of it brings to us. Drawing, also, is not compulsory; but your position on the scholarship list will be lower if you have no marks to count for previous success in this subject. To every pupil teacher, therefore, we say, try to pass in at least one subject in drawing in each year of your apprenticeship, and by attendance at a singing-class, or in some other way, get sufficient elementary knowledge of music at least as will enable you to take the music paper at the yearly examination.

Time must be provided for getting a knowledge of general literature, as well as a knowledge of school books. You will need some guidance in your choice of books. There are books and books. Let those you read be of a high class and character. Do not try to read too many. One good book a month, or even less, will be amply sufficient. When a book has been read, make an analysis of its contents, and try to reproduce the story or the argument in your own words. Keep a book for the purpose; it will be of infinite service in giving you a freer and fuller command of the English language, and it will strengthen your memory and increase your thinking and reasoning faculties. Among the books which you should regularly read should be one containing general information—a cyclopædia of a limited size. In your school work you come upon all sorts of references, and if you are not well-informed upon general subjects it will be impossible for you to explain these references to your class. In the newspapers and your own ordinary reading the same thing will occur. Object lessons are given in school, not only to train the children

in habits of attention and observation, but for the purpose of imparting information. A course of reading of a general character is the best preparation for lessons of this kind.

Many third and fourth year pupil teachers will be looking forward to the Queen's Scholarship Examination in July next. The fourth year pupil teachers will do well to spend the eight months, which must elapse before that time, in revision of the whole of the work of their apprenticeship, and in the preparation of the special papers which are now set in languages. In English colleges marks are given for one language; but in many of the colleges two languages are taken during the two years' course of training. For the one you intend to take at the examination, let the accidence be thoroughly well prepared. It gives an immense advantage to a student to have this at his finger's ends. It is to him what the knowledge of the tables is to a boy learning multiplication and division. Repetition aloud to some friend is very useful in fixing declensions, conjugations, and idioms in the mind. Let a few minutes be given every day to this, and the results will agreeably surprise any one who tries the plan.

Those pupil teachers who have only just taken third year's papers, will be somewhat handicapped in the race for places on the scholarship list. We would remind them, however, that the 'race is not always to the swift.' A steady, plodding toiler will not be much behind at the finish, and if you mean to win, don't let a day slip without making due progress, and feeling you are nearer the goal than ever.

Pupil Teachers in Scotland have an advantage over their brethren in England, for distinction in Latin or Greek, and in mathematics, entitles them to certain advantages, and increases their chances of getting a degree, without which the time will come when none will be allowed to teach. To these, sufficient inducement is already held out to do their best, but the prospect of a high place on the scholarship list, with its subsequent advantages, ought also to act as an incentive to hard work to English pupil teachers also.

Where it is possible to do so, every pupil teacher should attend a science class once a week during the winter months. Marks are given for a first class in the elementary stage, or a pass in the advanced stage of one science subject. There are twelve subjects named in the code to select from. Here, again, each will have to be guided by circumstances as to choice, but whichever is selected, let it be the one for which you have a natural taste if possible.

Do not, in your desire to do well in your studies, neglect your health or your physical training. Some exercise should be obtained *every day*, and at least half a day in the week should be wholly given up to it. Football, cricket, bicycling, and other athletic exercises should be taken up according to season or preference, always remembering that they must occupy their proper time alone, and must not encroach upon that to be devoted to work. By every means possible obtain information, but especially by observation. Often more can be learned in a day by this means than by many a night's work. As some guide towards forming a time-table we subjoin the time actually given by a successful pupil teacher and first-class Queen's scholar. Total hours of study during the week, twenty, which were devoted to ordinary code subjects (10), drawing (1), science (2), music, theoretical and practical (2), languages (3), and general reading (2). Some will probably require more for their ordinary work. If so, it can be obtained by devoting less time to the remaining subjects. We strongly advise every pupil teacher to pursue a similar plan.

Recent Inspection Questions.

[The Editor respectfully solicits contributions—all of which will be regarded as STRICTLY PRIVATE*—to this column. For obvious reasons, it cannot be stated in which district the questions have been set.]*

Arithmetic.

Standard I.

(1)	(2)	(3)
578	730	433
49	29	39
309	701	394
8		
75		
1019		

Standard II.

(1) 65,370 + 1,999 = 63,371

(2) 9)76,837
8537 + 4

(3) $7{,}985 \times 493 = 3{,}936{,}605$.

(4) $70{,}378 \times 8400 = 591{,}175{,}200$.

Standard III.

(1) Divide two hundred and one thousand five hundred and eight by two hundred and seven.

$201{,}508 \div 207 = 973\frac{97}{207}$ Ans.

(2) A gentleman had four five-pound notes. He paid away £6 16s. 3d. to his butcher, and £9 12s. 11d. to his tailor; how much had he left?

£20 − (£6 16s. 3d. + £9 12s. 11d.)
= £3 10s. 10d. Ans.

(3) Add together £7 0s. 4½d., £5,026 19s. 7¾d., £80,300 13s. 1½d., £826 18s. 7d.

£86,161 11s. 8¾d. Ans.

(4) From ten thousand and eighty-six pounds and sixpence halfpenny, take nine hundred and eighty-nine pounds seventeen shillings and three farthings.

£10,086 0s. 6½d. − £989 17s. 0¾d.
= £9,096 3s. 5¾d. Ans.

Standard IV.

(1) Multiply £79 17s. 6¾d. by 173.

£13,818 18s. 3¾d. Ans.

(2) Divide £6709 1s. 6¾d. by 95.

£70 12s. 5¼d. Ans.

(3) How many tons are there in 3,601,591 ozs.?

£100 tons 9 cwt. 3 qrs. 7lbs. 7 oz. Ans.

(4) How often is 3s. 8½d. contained in £11 6s. 7½d.?

£11 6s. 7½d. ÷ 3s. 8½d.
$5439 \div 89 = 61\frac{1}{89}$ times. Ans.

STANDARD V.

(1) Find the value of 48 tons 16 cwt. 3 qrs. at 18s. 6d. per ton.

	£	s.	d.	
10 cwt. = ½ ton	0	18	6	value of 1 ton
		48		
	44	8	0	,, 48 tons
5 cwt. = ½ of 10 c.	0	9	3	,, 10 cwt.
1 cwt. = ⅕ of 5 c.	0	4	7½	,, 5 ,,
2 qrs. = ¼ cwt.	0	0	11	,, 1 ,,
1 qr. = ½ of 2 qrs.	0	0	5½	,, 2 qrs.
	0	0	2¼	,, 1 ,,
Ans.	£45	3	5¾	,, 48tn. 16c. 3qrs.

(2) If 2 cwt. 2 qrs. cost £36 6s., how much can be bought for £72 12s.?

	cwt.	qrs.		cwt.
£36 6s. : £72 12s ::	2	2	:	5. Ans.

(3) Make out the following bill:—

	£	s.	d.
7 articles at 10½d. each	0	6	1½
17 ,, at 4½d. ,, ...	0	6	4½
5½ lbs. at 5d. per lb.	0	2	3½
7½ lbs. at 8d. ,, ...	0	5	2
78 pencils at 4d. per doz.	0	2	2
Ans.	£1	2	1½

(4) $\frac{2}{3} + \frac{1}{6} - \frac{1}{12}$. $\frac{7}{12}$. Ans.

STANDARD VI.

(1) If $\frac{2}{3}$ of $\frac{1}{4}$ of a pole is in the water and 50 feet out of the water, find the cost of the pole at 1s. 6d. per foot.

$1 - (\frac{2}{3}$ of $\frac{1}{4}) = \frac{6}{6} - \frac{1}{6} = \frac{5}{6}$

$\frac{5}{6}$ = 50 feet $\therefore \frac{6}{6}$ = 60 feet.

60 feet at 1s. 6d. = £4 10s. Ans.

(2) Divide ·7575 of £1 by $16\frac{2}{3}$, and give the answer in pence.

·7575 £ ÷ $16\frac{2}{3}$
= ·7575 × $\frac{3}{50}$
= ·7575 × $\frac{6}{100}$
= ·04545 £
= ·90900 s.
= 10·908 d. Ans.

(3) A can reap a field in 4 days, and B can do it in 6 days. In what time will they do it working together?

One day's work = $\frac{1}{4} + \frac{1}{6} = \frac{5}{12}$
Time to do $\frac{5}{12}$ = 1 day
,, $\frac{1}{12}$ = $\frac{1}{5}$ day
,, $\frac{2}{12}$ = $\frac{2}{5}$ days = 2$\frac{2}{5}$ days. Ans.

(4) Of what sum would the interest amount to £580 in 3 years at 4 per cent.?

The interest of £100 would be £4 × 3 = £12.
£12 : £580 :: £100 : £4833 6s. 8d. Ans.

STANDARD VII.

(1) How much per cent. does a farmer lose who purchases a score of calves at £5 2s. 6d. each, and sells the lot for £99 18s. 3d.?

£5 2s. 6d. × 20 = £102 10s. cost price.
£102 10s. − £99 18s. 3d. = £2 11s. 9d. total loss.
£102 10s. : £100 :: £2 11s. 9d. : £2$\frac{23}{41}$. Ans.

(2) What ready money will discharge a bill for £528 9s. due four months hence at £2 8s. 9d. per cent.?

£100 will produce $\frac{1}{3}$ of £2 8s. 9d. = 16s. 3d.
£100 16s. 3d. : £100 :: £528 9s. : £524 3s. 9$\frac{3}{41}\frac{3}{41}$d.

(3) A person invests 9000 guineas in the 3 per cents. at 81 and sells out when they have sunk to 67½. What does he lose by the transaction?

On every 81 invested he loses (81 − 67½) = 13½

gui.	gui.	gui.	gui.
81 :	9000 ::	13½ :	1500 = £1575. Ans.

(4) A grocer bought 46 lbs. of tea at 2s. 4d., 56 lbs. at 2s. 6d., and 66 lbs. at 2s. 8d. At what price per lb. must he sell the whole as a mixture so as to gain 5 guineas by his trading?

		£	s.	d.
46 at 2s. 4d.	=	5	7	4
56 at 2s. 6d.	=	7	0	0
66 at 2s. 8d.	=	8	16	0
168	for	21	3	4
	Gain =	5	5	0
168 sold for		26	8	4
1 lb. for		0	3	1$\frac{31}{168}$. Ans.

Grammar.

STANDARD IV.

Parse:—She took the flowers from the garden.

STANDARD V.

Analyse and parse:—Almost all the knives are made in that town.

STANDARDS VI. AND VII.

Analyse this sentence, and parse words in italics:—'The old trees *which you lately saw* in the field *are blown down* by the wind.'

Geography.

STANDARD II.

What is the difference between the water in a lake and that in a river? Where do you find coral? What colour is it? What do you call the highest piece of land? What do you call the largest piece? Is there any water in a continent? What do you call it? What is a breaker? a street? a cape? and a table-land?

STANDARD III.

Where is the Isle of Thanet? Name me two twin towns on the island. Where is the Gower Peninsula? How is Anglesey connected with Caernarvonshire? What goes through the tubular bridge? Name me a town in Anglesey from which ships sail to foreign countries? What divides the northern counties of England? What do you call that mountain at one of the ends of the Pennine Chain? How many Houses of Parliament are there? Into what is a county divided?

STANDARD V.

What kind of a river is the Rhine? What is its length? What are the productions of its valley? Name me towns on its banks. What is Cologne

noted for? Another name for Ehrenbreitstein? What are the lakes of Russia? What is the area of Ladoga? of Onega? What are the inhabitants of Holland called? What do we get from Holland? What kind of wine do we get from Bordeaux? Name me the productions of Italy. What is exported from Odessa? Where is the Iron Gate? What is the King of Turkey called? What causes day and night? How many seasons are there? What do you call the different lines on a map? What is a globe? A meridian?

STANDARD VII.

What causes winds? Name some ocean currents. Describe the Gulf Stream? Name a large fish in the sea. Another. What do you mean by sounding the sea? Describe a sounding apparatus?

Query Column.

RULES.

1. Each correspondent is restricted to *one question*. We should be much obliged if correspondents, who send questions for solution, would give (if possible) the required answer, and the source from which the question is obtained.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. ☞ When a pseudonym is adopted it should be written at the end of the query, and the real name and address on a separate piece of paper.

4. Correspondents are requested to write their queries *legibly*, and on one side of the paper only.

5. Replies will not be sent through the post.

6. Queries must reach the office *not later than the 12th of the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed—'*The Query Editor*,' *The Practical Teacher, Pilgrim Street, Ludgate Hill, London, E.C.*

Algebra.

1. A PERPLEXED ONE.—Solve:—

$$\frac{x}{a}+\frac{y}{b}=2,\ \frac{x^2}{a}+\frac{y^2}{b}=a+b. \quad (Todhunter.)$$

$$\left.\begin{aligned}(1)\ &\frac{x}{a}+\frac{y}{b}=2\\ (2)\ &\frac{x^2}{a}+\frac{y^2}{b}=a+b\end{aligned}\right\}$$

$$(1)\ \frac{x}{a}+\frac{y}{b}=2$$

$$\frac{y}{b}=2-\frac{x}{a}$$

$$=\frac{2a-x}{a}$$

$$\therefore\ y=\frac{b(2a-x)}{a}.$$

$$(2)\ \frac{x^2}{a}+\frac{y^2}{b}=a+b$$

$$\frac{x^2}{a}+\frac{b(2a-x)^2}{a^2}=a+b$$

$$ax^2+b(4a^2-4ax+x^2)=a^3+a^2b$$

$$ax^2+4a^2b-4abx+bx^2=a^3+a^2b$$

$$(a+b)x^2-4abx=a^3-3a^2b$$

$$x^2-\frac{4abx}{a+b}=\frac{a^3-3a^2b}{a+b}$$

$$x^2-\frac{4abx}{a+b}+\left(\frac{2ab}{a+b}\right)^2=\frac{a^3-3a^2b}{a+b}+\frac{4a^2b^2}{(a+b)^2}$$

$$=\frac{a^4-2a^3b-3a^2b^2+4a^2b^2}{(a+b)^2}$$

$$=\frac{a^4-2a^3b+a^2b^2}{(a+b)^2}$$

$$x-\frac{2ab}{a+b}=\pm\frac{a^2-ab}{a+b}$$

$$x=\pm\frac{a^2-ab}{a+b}+\frac{2ab}{a+b}$$

$$=\frac{a^2+ab}{a+b},\ \text{or}\ \frac{-a^2+3ab}{a+b}$$

$$\therefore\ x=a,\ \text{or}\ \frac{a(3b-a)}{a+b}.$$

$$\therefore\ y=\frac{b}{a}(2a-x)$$

$$=\frac{b}{a}(2a-a),\ \text{or}\ \frac{b}{a}\left\{2a-\frac{a(3b-a)}{a+b}\right\}$$

$$=\frac{b}{a}\times a,\ \text{or}\ \frac{b}{a}\left(\frac{2a^2+2ab-3ab+a^2}{a+b}\right)$$

$$=b,\ \text{or}\ \frac{b}{a}\left(\frac{3a^2-ab}{a+b}\right)$$

$$=b,\ \text{or}\ \frac{b}{a}\times\frac{a(3a-b)}{a+b}$$

$$=b,\ \text{or}\ \frac{b(3a-b)}{a+b}.$$

2. CICERO.—Solve:—

$$x^2+xy=a(a+b),\ x^2+y^2=a^2+b^2. \quad (Todhunter.)$$

$$\left.\begin{aligned}(1)\ &x^2+xy=a(a+b)\\ (2)\ &x^2+y^2=a^2+b^2\end{aligned}\right\}$$

Put $y=vx$,

Then, $\left.\begin{aligned}(1)\ &x^2(1+v)=a(a+b)\\ (2)\ &x^2(1+v^2)=a^2+b^2\end{aligned}\right\}$

$$\frac{1+v}{1+v^2}=\frac{a^2+ab}{a^2+b^2}$$

$$a^2+b^2+v(a^2+b^2)=a^2+ab+v^2(a^2+ab)$$

$$v^2(a^2+ab)-v(a^2+b^2)=b^2-ab$$

$$v^2-\frac{a^2+b^2}{a^2+ab}v=\frac{b^2-ab}{a^2+ab}$$

$$v^2-\frac{a^2+b^2}{a^2+ab}v+\left\{\frac{a^2+b^2}{2(a^2+ab)}\right\}^2$$

$$=\frac{b^2-ab}{a^2+ab}+\frac{(a^2+b^2)^2}{4(a^2+ab)^2}$$

$$=\frac{4(b^2-ab)(a^2+ab)+(a^2+b^2)^2}{4(a^2+ab)^2}$$

$$=\frac{(a^2+b^2)^2+4^2ab^3-a^2b)}{4(a^2+ab)^2}$$

$$=\frac{a^4+2a^2b^2+b^4+4ab^3-4a^3b}{4(a^2+ab)^2}$$

$$=\frac{a^4-4a^3b+2a^2b^2+4ab^3+b^4}{4(a^2+ab)^2}$$

$$v-\frac{a^2+b^2}{2(a^2+ab)}=\pm\frac{a^2-2ab-b^2}{2(a^2+ab)}$$

$$v=\frac{\pm(a^2-2ab-b^2)+a^2+b^2}{2(a^2+ab)}$$

$$=\frac{2a^2-ab}{2(a^2+ab)},\ \text{or}\ \frac{2ab+b^2}{2(a^2+ab)}$$

$$=\frac{2a(a-b)}{2a(a+b)},\ \text{or}\ \frac{2b(a+b)}{2a(a+b)}$$

$$\therefore\ v=\frac{a-b}{a+b},\ \text{or}\ \frac{b}{a}.$$

(1) $x^2(1+v)=a(a+b)$

$x^2\left(1+\frac{b}{a}\right)$, or $x^2\left(1+\frac{a-b}{a+b}\right)=a(a+b)$

$x^2\left(\frac{a+b}{a}\right)$, or $x^2\left(\frac{2a}{a+b}\right)=a(a+b)$

$x^2=a(a+b)\times\frac{a}{a+b}$, or $a(a+b)\times\frac{a+b}{2a}$

$=a^2$, or $\frac{(a+b)^2}{2}$

$\therefore x=\pm a$, or $\pm\frac{a+b}{\sqrt{2}}$.

$\therefore y=vx$

$=\pm a\times\frac{b}{a}$, or $\pm\frac{a+b}{\sqrt{2}}\times\frac{a-b}{a+b}$

$=\pm b$, or $\pm\frac{a-b}{\sqrt{2}}$.

Note.—The solution of the other equation appeared in our issue for March, 1885.

3. NOBODY.—At what price per yard did I buy 80 yards of cloth, if having sold $\frac{1}{2}$ of it at a profit of as much per £100 as 8 yards cost me, and the remainder at a profit of as much per £100 as $7\frac{1}{2}$ yards cost me, my total gain was 17s. 3d.? (*Colenso.*)

Let x = Cost price per yard in shillings;

Then, $\left(x\times\frac{8}{100}\times\frac{8x}{20}\right)+\left(x\times\frac{7\frac{1}{2}}{100}\times\frac{7\frac{1}{2}x}{20}\right)=17\frac{1}{4}$

$\left(\frac{80x}{3}\times\frac{x}{250}\right)+\left(\frac{160x}{3}\times\frac{3x}{800}\right)=17\frac{1}{4}$

$\frac{8x^2}{75}+\frac{x^2}{5}=\frac{69}{4}$

$\frac{8x^2+15x^2}{75}=\frac{69}{4}$

$\frac{23x^2}{75}=\frac{69}{4}$

$x^2=\frac{69}{4}\times\frac{75}{23}$

$=\frac{225}{4}$

$\therefore x=\frac{15}{2}$.

$\therefore$ Cost price per yard $=\frac{15}{2}$s.

$=$ 7s. 6d. Ans.

4. HERNE HILL.—Solve:—

$$\left.\begin{aligned}\frac{x}{p}+\frac{y}{q}&=1-\frac{x}{r}\\ \frac{x}{q}+\frac{y}{p}&=1+\frac{x}{r}\end{aligned}\right\}$$ (*Loudon.*)

$$\left.\begin{aligned}(1)\ \frac{x}{p}+\frac{y}{q}&=1-\frac{x}{r}\\ (2)\ \frac{x}{q}+\frac{y}{p}&=1+\frac{x}{r}\end{aligned}\right\}$$

$$\left.\begin{aligned}(1)\ \frac{x}{p}+\frac{x}{r}+\frac{y}{q}&=1\\ (2)\ \frac{x}{q}-\frac{x}{r}+\frac{y}{p}&=1\end{aligned}\right\}$$

$$\left.\begin{aligned}(1)\ \frac{(p+r)x}{pr}+\frac{y}{q}&=1\\ (2)\ \frac{(r-q)x}{qr}+\frac{y}{p}&=1\end{aligned}\right\}$$

$$\left.\begin{aligned}(1)\times q\ \ (1)\ \frac{q(p+r)x}{pr}+y&=q\\ (2)\times p\ \ (2)\ \frac{p(r-q)x}{qr}+y&=p\end{aligned}\right\}$$

Subtracting $\frac{p(r-q)x}{qr}-\frac{q(p+r)x}{pr}=p-q$

$\frac{\{p^2(r-q)-q^2(p+r)\}x}{pqr}=p-q$

$\frac{\{(p^2-q^2)r-pq(p+q)\}x}{pqr}=p-q$

$\frac{[(p+q)\{(p-q)r-pq\}]x}{pqr}=p-q$

$\therefore x=\frac{pqr(p-q)}{(p+q)\{(p-q)r-pq\}}$

$=\frac{pq}{p+q}\cdot\frac{(p-q)r}{(p-q)r-pq}$

(1) $\frac{(p+r)x}{pr}+\frac{y}{q}=1$

$\frac{y}{q}=1-\frac{p+r}{pr}\cdot\frac{pq}{p+q}\cdot\frac{(p-q)r}{(p-q)r-pq}$

$=\frac{r(p+q)\{(p-q)r-pq\}-q(p+r)(p-q)r}{r(p+q)\{(p-q)r-pq\}}$

$=\frac{(p^2-q^2)r^2-pqr(p+q)-qr(p^2+pr-pq-qr)}{r(p+q)\{(p-q)r-pq\}}$

$=\frac{p^2r^2-q^2r^2-p^2qr-pq^2r-p^2qr-pqr^2+pq^2r+q^2r^2}{r(p+q)\{(p-q)r-pq\}}$

$=\frac{p^2r^2-2p^2qr-pqr^2}{r(p+q)\{(p-q)r-pq\}}$

$=\frac{p^2\{(p-q)r-2pq\}}{(p+q)\{(p-q)r-pq\}}$

$\therefore y=\frac{pq}{p+q}\cdot\frac{(p-q)r-2pq}{(p-q)r-pq}$.

5. BURRELL.—Find the greatest term of $(1-x)^{-n}$ when $x=\frac{7}{12}$ and $n=\frac{5}{3}$; and of $(1+x)^{-n}$ when $x=\frac{2}{7}$ and $n=3$.

(1) $(1-x)^{-n}$ when $x=\frac{7}{12}$ and $n=\frac{5}{3}$;

In this case the numerical value of the $(r+1)$th term may be found by multiplying that of the rth term by $\left(\frac{5}{3r}+1\right)\frac{7}{12}$;

This multiplier first becomes less than 1 when $r=3$;

$\therefore$ Third term is the greatest.

$\therefore$ 3rd term $=\frac{-\frac{5}{3}(-\frac{5}{3}-1)}{1\cdot2}(-\frac{7}{12})^2$

$=\frac{8\cdot11}{3\cdot6}(\frac{7}{12})^2$.

(2) $(1+x)^{-n}$ when $x=\frac{2}{7}$ and $n=3$;

In this case the numerical value of the $(r+1)$th term may be found by multiplying that of the rth term by $\left(\frac{2}{r}+1\right)\frac{2}{7}$;

This multiplier is equal to 1 when $r=5$, so that the 6th term is equal to the 5th, and these are greater than any other.

$\therefore$ 5th and 6th terms $=\frac{-3(-3-1)(-3-2)(-3-3)}{\lfloor4}(\frac{2}{7})^4$

$=\frac{3\cdot4\cdot5\cdot6}{\lfloor4}(\frac{2}{7})^4$

$=\frac{2^4\cdot3^2\cdot5}{7^4}$.

6. J. RATHHAUS.—Suppose the number of combinations of n things taken r together to be equal to the number taken $r+1$ together, and that each of these equal numbers is to the number of combinations of n things taken $r-1$ together as 5 is to 4, find the value of n.

The combinations which are equal in number must be complementary;

$\therefore n=r+r+1$

$=2r+1$;

$\therefore\frac{\lfloor n}{\lfloor r\,\lfloor r+1}=\frac{5}{4}\cdot\frac{\lfloor n}{\lfloor r-1\,\lfloor r+2}$

$\frac{\lfloor r-1\,\lfloor r+2}{\lfloor r\,\lfloor r+1}=\frac{5}{4}$,

$\frac{r+2}{r}=\frac{5}{4}$,

$\frac{2}{r}=\frac{1}{4}$,

$\therefore r=8$;

$\therefore n=2r+1$

$=17$.

7. QUINTINE.—From a company of soldiers mustering 96, a picket of 10 is to be selected; determine in how many ways it can be done (1), so as always to include a particular man, (2) so as always to exclude the same man. (*Todhunter.*)

(1) When the particular man is included, we have to select 9 men out of 95;

This can be done in $\frac{\lfloor95}{\lfloor9\,\lfloor86}$ ways.

(2) When the particular man is excluded, we have to select 10 men out of 95;

This can be done in $\frac{\lfloor 95}{\lfloor 10 \,\lfloor 85}$ ways.

8. NIL DESPERANDUM.—Assuming that the coefficient of x^{r-1} in the continued product of the $n-1$ factors $(x-a_1)(x-a_2)\ldots\ldots(x-a_{n-1})$ is the sum of the products of $(n-1)$ letters $a\ldots\ldots a_{n-1}$ taken $r-1$ together, prove, by the introduction of another factor, that the law holds good for the coefficient of x in the continued product of n such factors. (*Certificate*, 1884.)

Suppose,

$$(x-a_1)(x-a_2)\ldots\ldots(x-a_{n-1})$$
$$=x^{n-1}-p_1x^{n-2}+p_2x^{n-3}-p_3x^{n-4}+\ldots\ldots$$

Where p_1 = Sum of the terms $a_1, a_2, \ldots\ldots a_{n-1}$,
p_2 = Sum of the products of these terms taken two at a time,
p_3 = Sum of the products of these terms taken three at a time;

Multiply both sides by another factor $(x-a_n)$;

Then,

$$(x-a_1)(x-a_2)\ldots\ldots(x-a_n)$$
$$=x^n-(p_1+a_n)x^{n-1}+(p_2+p_1a_n)x^{n-2}-(p_3+p_2a_n)x^{n-3}+\ldots\ldots$$

Now, p_1+a_n = Sum of all the terms $a_1, a_2, \ldots\ldots a_n$;

$p_2+p_1a_n = p_2+a_n(a_1+a_2+\ldots\ldots a_n)$
= Sum of the products taken two at a time of all the terms of $a_1, a_2, \ldots\ldots a_n$;

$p_3+p_2a_n = p_3+a_n(a_1a_2+a_2a_3+a_1a_3+\ldots\ldots)$
= Sum of the products taken three at a time of all the terms of $a_1, a_2, \ldots\ldots a_n$.

Hence, if the laws hold when $n-1$ factors are multiplied together, they hold when n factors are multiplied together.

9. THANKFUL.—If the logarithms of three quantities are in arithmetical progression, prove that the quantities are in continued proportion.

Given $\frac{4^x}{2^{x+y}}=8$, and $x=3y$, find x and y. (*Hamblin Smith.*)

Let x = Base of logarithms, and 1, 2, and 3 the logarithms, or that
x, x^2, and x^3 = The three quantities;
Now, 1, 2, and 3 are in Arithmetical Progression,
and $x:x^2::x^2:x^3$.

$$\frac{4^x}{2^{x+y}}=8$$
$$\frac{4^{3y}}{2^{4y}}=8$$
$$4^{3y}=8\times 2^{4y}$$
$$(2^2)^{3y}=2^3\times 2^{4y}$$
$$2^{6y}=2^{4y+3}$$
$$\therefore 6y=4y+3$$
$$2y=3$$
$$\therefore y=\tfrac{3}{2}.$$
$$\therefore x=3y=\tfrac{9}{2}.$$

10. W. DAWSON.—Solve:— (*Science and Art*, 1871.)

$$\left.\begin{aligned} y^4&=x^3(ay-bx)\\ x^2&=ax-by\end{aligned}\right\}$$

$$\left.\begin{aligned}(1)\ y^4&=x^3(ay-bx)\\ (2)\ x^2&=ax-by\end{aligned}\right\}$$

$$\left.\begin{aligned}(2)\ x^2&=ax-by\\ (1)\ \frac{y^4}{x^2}&=ay-bx\end{aligned}\right\}$$

Subtracting $\left.\begin{aligned} x^2-\frac{y^4}{x^2}&=ax-ay+bx-by\\ \frac{x^4-y^4}{x^2}&=a(x-y)+b(x-y)\\ &=(a+b)(x-y)\end{aligned}\right.$

Dividing each side by $x-y$ $\left.\begin{aligned}\frac{(x^2+y^2)(x+y)}{x^2}&=a+b.\end{aligned}\right.$

As we divided each side by $x-y$,
$$x-y=0.$$
$$\therefore x=y.$$
$$(2)\ x^2=ax-bx$$
$$=x(a-b)$$
$$\therefore x=a-b.$$

And as we divided each side by x, $\therefore x=0$.
$\therefore x=y=a-b$, or 0.

11. ERNEST NEVES.—Prove that any number in the denary scale is divisible by 11, if the difference between the respective sums of the odd and even digits is divisible by 11.

Let N denote the whole number, $a_0, a_1, \ldots a^n$, the digits beginning with that in the units' place, and let x denote the radix of the scale.

Then, $N=a_0+a_1x+a_2x^2+\ldots\ldots+a_nx^n$
$=a_0-a_1+a_2-a_3+\ldots\ldots+(-1)^na_n$
$+a_1(x+1)+a_2(x^2-1)+a_3(x^3+1)+\ldots$
$+a_n\{x^n-(-1)^n\}$;

Thus, $\frac{N}{x+1}=\text{Some integer}+\frac{a_0-a_1+a_2-\ldots+(-1)^na_n}{x+1}$

$\therefore$ If $a_0-a_1+a_2-\ldots\ldots+(-1)^na_n$ be divisible by $x+1$, the whole number N is divisible by $x+1$.

Wherefore, in the denary scale, if the difference between the respective sums of the odd and even digits be divisible by (10+1), or 11, the whole number is divisible by 11.

Mensuration.

1. BRUCE.—The breadth of a room is two-thirds of its length and three-halves of its height, and the contents are 5832 cubic feet. Find the dimensions of the room. (*Hamblin Smith.*)

Length in ft. × Breadth in ft. × Height in ft.
= 5832 cub. ft.,
$\frac{2}{3}$ Breadth in ft. × Breadth in ft. × $\frac{3}{2}$ Breadth in ft.
= 5832 cub. ft.,
$\frac{2}{3}\times\frac{3}{2}$ (Breadth in ft.)^3 = 5832 cub. ft.,
(Breadth in ft.)^3 = 5832 cub. ft.,
$\therefore$ Breadth = $\sqrt[3]{5832 \text{ cub. ft.}}$
= 18 ft.

Length = $\frac{3}{2}$ of 18 ft. = 27 ft.;
Height = $\frac{2}{3}$ of 18 ft. = 12 ft.

2. X. Y. Z.—The sides of a hexagonal room require for papering four pieces of paper 20 inches wide, each piece being 10 yards long. The area of the floor is 384 sq. ft.; find the height of the room. (*Certificate*, 1878.)

Area of walls = 4(10 yds. × 20 in.)
= 4(30 × $\frac{2}{3}$) sq. ft.
= 200 sq. ft.

Area of equilateral triangle = Side^2 × ·433;
Area of floor = (Side^2 × ·433) × 6,
384 sq. ft. = (Side^2 × ·433) × 6,
Side^2 × ·433 = 64 sq. ft.;
$$\text{Side}^2=\frac{64}{\cdot 433}\text{ sq. ft.}$$
$$=147\cdot 806\ldots\text{ sq. ft.}$$
$$\therefore \text{Side}=\sqrt{147\cdot 806\ldots}\text{ ft.}$$
$$=12\cdot 157\ldots\text{ ft.}$$

$$\therefore \text{Height of room}=\frac{\frac{200}{100}\text{ sq. ft.}}{12\cdot 157\times\frac{3}{4}\text{ ft.}}$$
$$=\frac{100}{36\cdot 471}\text{ ft.}$$
$$=2\cdot 7419\ldots\text{ ft. Ans.}$$

3. J. W. D.—A plantation in the shape of an ellipse has diameters which measure respectively 110 yds. and 73 yds. 1 ft.; how many stakes will be wanted to fence it if they are placed 10 inches apart? (*Lewis.*)

$$\text{Circumference}=\frac{110\text{ yds.}+73\text{ yds. }1\text{ ft.}}{2}\times 3\cdot 1416$$
$$=\frac{330+220}{2}\text{ ft.}\times 3\cdot 1416$$
$$=(550\times 1\cdot 5708)\text{ ft.}$$
$$=803\cdot 94\text{ ft.}$$
$$=10{,}367\cdot 28\text{ in.};$$
$\therefore$ No. of stakes reqrd. = 10,367 + 10
= 1,036. Ans.

Arithmetic.

1. IGNORAMUS.—Three trains, 200, 528, 130 yards long, are travelling on parallel lines at rates of 15, 24, and 30 miles per hour respectively, the first two in the same direction, the third meeting them; the second reaches the rear of the first train at the same moment as the third reaches its front; find the interval in time between the moments when each of the two trains clears the third. (*Certificate*, 1884.)

Time for second train to pass the first train

$$= \frac{(200+528)\text{ yds.}}{(24-15)\text{ miles}} \text{ of an hour}$$

$$= \frac{\overset{91}{\cancel{728}} \times \overset{4}{\cancel{60}}}{\underset{3}{\cancel{9}} \times \underset{11}{\cancel{1760}}} \text{ min.}$$

$$= 5\tfrac{1}{11} \text{ min.}$$

$$= 2 \text{ min. } 45\tfrac{5}{11} \text{ sec.;}$$

Time for third train to pass the first train

$$= \frac{(200+130)\text{ yds.}}{(15+30)\text{ miles}} \text{ of an hour}$$

$$= \frac{\overset{7}{\cancel{330}} \times \overset{4}{\cancel{60}}}{\underset{11}{\cancel{45}} \times \underset{4}{\cancel{1760}}} \text{ min.}$$

$$= 1 \text{ min.}$$

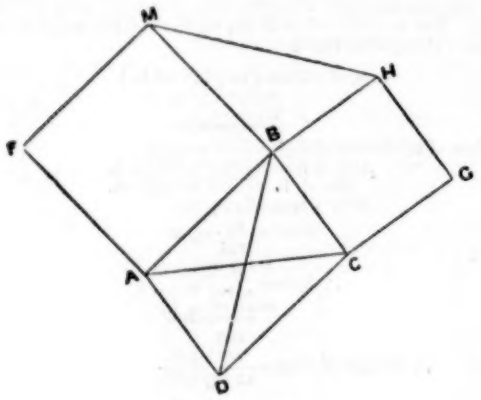
$$= 15 \text{ sec.;}$$

$\therefore$ Interval $= 2 \text{ min. } 45\tfrac{5}{11} \text{ sec.} - 15 \text{ sec.}$

$= \underline{2 \text{ min. } 30\tfrac{5}{11} \text{ sec.}}$ Ans.

Geometry.

1. IGNORAMUS.—If ABMF and BCGH be squares described upon the sides AB and BC of any triangle, show that the squares on AC and MH are together double of the squares on AB and BC.



Complete parallelogram ABCD and join BD.

Proof.—$\angle$s ABM and CBH are right angles,

$\therefore$ $\angle$s ABC and MBH are together equal to two right angles (I. 15, Cor. 2);

Because AB, CD are parallel,

$\therefore$ $\angle$s ABC, BCD are together equal to two right angles (I. 29);

Wherefore $\angle$ BCD $=$ $\angle$ MBH,

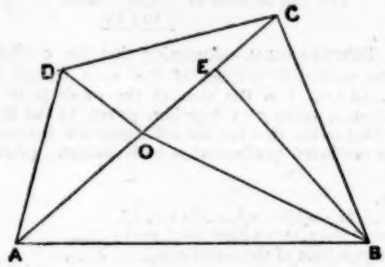
$\therefore$ base BD $=$ base MH. (I. 4.)

Again, ABCD being a parallelogram, $AC^2 + BD^2 = 2AB^2 + 2BC^2$,

$\therefore$ $\underline{AC^2 + MH^2 = 2AB^2 + 2BC^2}$. Q. E. D.

2. FOLKESTONIAN.—The sum of the squares on the distances of the middle point of either of the diagonals of a quadrilateral from the angles is equal to half the sum of the squares on the four sides.

Let ABCD be a quadrilateral, and let the diagonal AC be bisected in O, and join OB, OD.



Then the squares on OA, OB, OC, OD shall be equal to half the sum of the squares on AB, BC, CD, DA.

Draw BE perpendicular to AC.

Proof.—In the triangle AOB,

$AB^2 = OA^2 + OB^2 + 2AO.OE$, (II. 12.)

and in the triangle COB,

$BC^2 = OC^2 + OB^2 - 2CO.OE$;

But $OA = OC$,

$\therefore$ $AB^2 + BC^2 = 2OA^2 + 2OB^2$.

Similarly it can be proved that

$CD^2 + DA^2 = 2OC^2 + 2OD^2$;

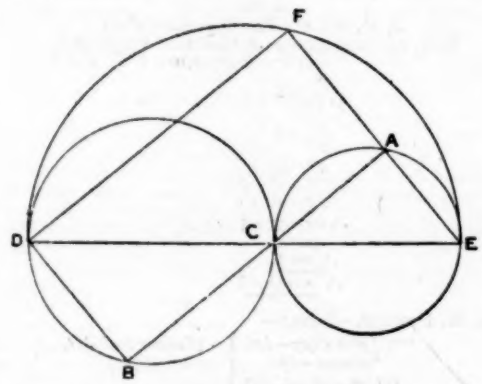
Wherefore $AB^2 + BC^2 + CD^2 + DA^2$

$= 2OA^2 + 2OB^2 + 2OC^2 + 2OD^2$;

$\therefore$ $\underline{OA^2 + OB^2 + OC^2 + OD^2 = \tfrac{1}{2}(AB^2 + BC^2 + CD^2 + DA^2)}$.

Q. E. D.

3. ARTHUR.—Two circles touch each other externally at C; show how to draw a straight line through C to meet the circumferences at A and B respectively, so that AB may be equal to a given straight line, less than the sum of the diameters of the circles. (*Science and Art*, 1885.)



Draw the straight line DCE passing through the centres of the two circles. (III. 12.)

Upon DE describe a semicircle, and from D with the distance equal to the given straight line cut the semicircle in F.

Join FE, cutting circumference of circle CE in A.

Join AC, and produce it to meet the circumference of circle CD in B.

Then AB shall be equal to the given straight line.

Join FD, DB.

Proof.—$\angle$s CAE, DFE are right angles, (III. 31.)

$\therefore$ AB, FD are parallel; (I. 28.)

Also $\angle$ CBD is a right angle;

$\therefore$ BD, EF are parallel; (I. 27.)

Wherefore ABDF is a parallelogram,

and $\underline{AB = DF \text{ (I. 34)}} =$ The given straight line, Q. E. F.

General.

1. TIP.—(1) The solution of your query appeared in our issue for June, 1882. (2) It is impossible when the three given lines are parallel, and the first line is not midway between the other two lines.

2. DISCIPULUS.—Your query was solved in our issue for May, 1882.

3. FOX.—You will find the solution of your query in our issue for May, 1883.

4. QUÆSUMUS.—The solution of your query appeared in our issue for May, 1885.

5. NIL DESPERANDUM.—Your query was solved in our issue for May, 1883.

6. A. LINDSAY.—The logarithm of 1·0442... is ·018814375. It is obtained from the book of Logarithmic Tables.

7. GUBAT.—The solution of your query appeared in our issue for September, 1885.

8. EDWARD.—You will find the sclution of your query in our issue for September, 1883.

9. CYCLOPS.—Your query was solved in our issue for March, 1883.

10. E. E.—Two figures are constructed as in the preceding propositions, viz., the figure AEFD and the figure MELK.

11. BROWNIE.—Small hand, 85; large hand, 75.

12. BEAUCLERK.—We have no means of finding out what you want. You can write to the secretary. We can recommend good books, but we cannot tell you what books are used in any particular establishment.

13. DUBIUS.—(1) Like may be a verb, as, 'I like to go,' and in old English an impersonal verb, as, 'It likes me not,' 'Me it likes.' (2) It may be an adjective, as, 'She is like a child'; like is here equivalent to the Latin *similis*. (3) It may be a conjunction, as, 'He walks like his father,' *i.e.*, like his father walks. 'He walks like me' is not a correct construction, as there can be no comparison between a person and an act.

14. SCOTIA.—A pupil teacher, in her 3rd year, can sit for the Scholarship Examination; you know the consequence if she fails. If you refer to the Code, article 84, you will see that the young woman of 18 counts on the school staff for forty scholars.

15. L'ECOLIER.—(1) We should strongly recommend you to take the elementary stage, and get a first class in it. (2) Yes, you might expect to be successful if you studied the books you name, taking care to observe and think as you go on. (3) Certainly. Many have done so. Try *Franklin Taylor's* 'Pianoforte Instructor,' and read *Novello's* 'Pianoforte Primer,' by Pauer.

16. ESSAYIST.—We will re-express the meaning of any phrase you wish, but cannot paraphrase long extracts where the general drift is quite plain. The peculiar words in this case are nearly all explained in the notes; see also this magazine, page 346.

17. CONFIDANT.—There can be little doubt but that you must wait two years more. It may be a question for the inspector's discretion. It seems quite clear to us that you have changed schools in the meaning of the regulations.

18. I. H. R.—The neatest solution is this:—

$$R^2 = P^2 + Q^2 + 2PQ \cos \alpha$$

$$\therefore \cos \alpha = \frac{R^2 - P^2 - Q^2}{2PQ}$$

$$= \frac{34225 - 1225 - 27225}{11550}$$

$$= \frac{5775}{11550} = \frac{1}{2}$$

But the angle whose Cos is $\frac{1}{2}$ is 60°.

But you can solve the problem geometrically, as Newth points out. Take the two forces acting at an angle of 60° and find their resultant as he shows you. You will see that it is the same as the one given. You will find the following books useful. *Twisden's* 'Theoretical Mechanics' (Longman); 'Textbook of Geology,' by *Jukes-Browne* (last edition); *Tanner's* manuals on agriculture.

19. INDUSTRY.—Slopes irregular and too great; joinings are at varying heights, and many are incomplete; the shape of the letters in most cases is incorrect; you have got a good idea of writing, bu you need to work from excellent models.

20. J. ALLINSON.—Rivington publishes the 'De Amicitia' by the editor you name. We fear the 'De Senectute' is not yet done.

21. ANER.—The possession of the degree you name would not affect the case in any way. The only thing you need consider is whether the subjects you have studied will assist you in the competitive examination for securing entrance, and that further depends upon the subjects you select for the degree. Hence you must decide what branch of the service you will select.

22. HOSPES.—Use *Tanner's* manual (Macmillan and Co.), also Chambers'. For Political Economy, use *Jevons'* Primer and *Fawcett's* Manual, either the small one, or much better, the large one. Geography, *Hewitt's* 'Colonies.' History, *Justin McCarthy's* 'History of Our Own Time' (cheap edition).

23. F. W. G.—A few copies of Vol. III. remain, and will be sent carriage free upon the receipt of 7s. 6d. per volume. We presume you will have to wait two years for your parchment from the time you were qualified by passing in the 2nd class.

24. A YOUNG TEACHER.—We do not know of any examination by the body you name.

25. EXCELSIOR.—Take our advice, and do not buy any more. If you are master of the books you name, then spend the time you have to spare in reading something else, say French, or if you have not done so, in learning to draw. Do not begin economy at present.

Any passages that are difficult to understand, whether in poetry or prose, will suit your purpose.

26. HYGIENE.—You read the essays, but not for grammatical purposes. The 'Tempest' is the literary subject. Writing, 70. We are glad you have profited by the notes on the 'Tempest' in this magazine.

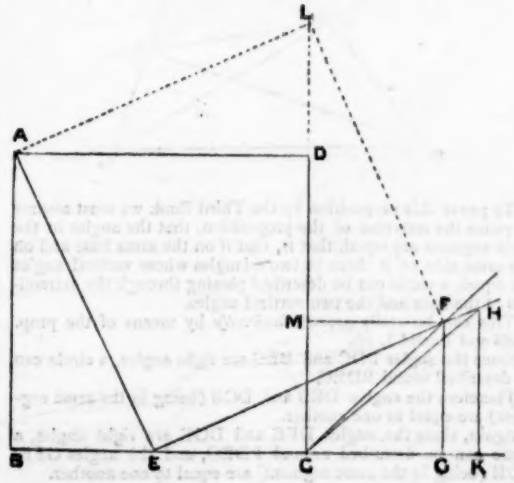
27. BRUCE.—Writing (1), 60; (2), 45. The number of marks is not published. You cannot find out. Nobody requires to know the latitude and longitude of more than a very few places by heart. Do not try to cram your memory with such useless facts while there is so much that is really important to learn. There is no book such as you inquire for.

28. ——By the making of poetry we suppose you mean prosody. If so, you will find some useful information in *Rev. E. Daniel's* 'English Language' (National Society).

29. FRED.—The order of words in Latin is much freer than in English. Generally the subject comes first, and the predicate follows. When a sentence consists of a subject, verb, and object, the order is subject, object, verb, each of these being attended by the words that specially relate to it.

30. IGNORAMUS.—*Corfield's* 'Laws of Health,' a small and cheap manual by Longmans, would give you all you want on the subject of ventilation.

31. VINGT-SIX.—ABCD is a square, and E any point in BC; a straight line EF is drawn at right angles to AE, and meets the straight line, which bisects the angle between CD and BC produced, in a point F. Prove that AE is equal to EF.



Let the figure be drawn as described in the enunciation.

If EF be not equal to EA, from EF (produced if necessary), cut off EH equal to EA, and from F, H, draw FG, HK perpendicular to BC produced.

Since BK is a straight line, and AEH is a right angle,
Therefore AEB and HEK are together = a right angle.
But since ABE is a right angle,
Therefore BAE and AEB are together = a right angle.
Therefore AEB and HEK are = BAE and AEB.
Take away the common angle AEB.
Therefore the remaining angle HEK = remaining angle AEB, and ABE and HKE are equal, being right angles, and AE is = EH (by constr.).
Therefore the triangles ABE and EKH are equal in all respects, that is, AB = EK and BE = HK.
Since BC = AB = EK.
Take away the common part EC.
Therefore the remainder BE = remainder CK.

But BE is = HK.
∴ CK = HK.

And therefore the angle KHC = angle KCH,
And since the angle CKH is a right angle,
Therefore KCH is half a right angle.
But GCF is = half a right angle (hyp.).
Therefore HCK = FCK, which is impossible.
Therefore EF is not unequal to AE; that is, it is equal to it.
Q. E. D.

The student must not be astonished to find this proposition proved *indirectly*, that is, by a *reductio ad absurdum*. The problem is the converse of a part of the well-known scissors proof of Euclid I. 47, which can be proved directly.

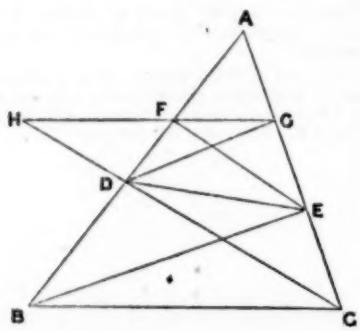
If two squares, ABCD and MCGF, be placed so that BC and CG are in the same straight line, and the figures ABE and EGF be cut off and placed as LMF and ADL respectively; the figure AEFL will be formed, which is the square on the side EF of the triangle EGF; ABCD and MCGF being the squares on the two sides BC, that is, EG and GF.

The student will notice that nearly every proposition, which is the converse of one that has gone before, is proved in Euclid indirectly: *e.g.*, the 6th, 14th, 19th, 39th, 40th, etc., of his First Book.

32. D. U. and JAMES DICKSON.—ABC is a triangle. From B, BE is drawn perpendicular to AC, and from E, EF is drawn perpendicular to AB. From C, CD is drawn perpendicular to AB, and from D, DG is drawn perpendicular to AC: prove that FG is parallel to the base BC.

Let the figure be drawn as enunciated, and let CD and GF be produced to meet in H.

Join DE.



To prove this proposition by the Third Book we must assume or prove the converse of the proposition, that the angles in the same segment are equal, that is, that if on the same base and on the same side of it there be two triangles whose vertical angles are equal, a circle can be described passing through the extremities of the base and the two vertical angles.

This can be easily proved *indirectly* by means of the prop. itself and Euclid I. 16.

Since the angles BDC and BEC are right angles, a circle can be described round BDEC.

Therefore the angles DEB and DCB (being in the same segment) are equal to one another.

Again, since the angles DFE and DGE are right angles, a circle can be described around FDEG, and the angles GFE, GDE (being in the same segment) are equal to one another.

Since EF and CH are both at right angles to AB, they are parallel to one another.

Therefore the exterior angle GFE is = interior and opposite angle FHG.

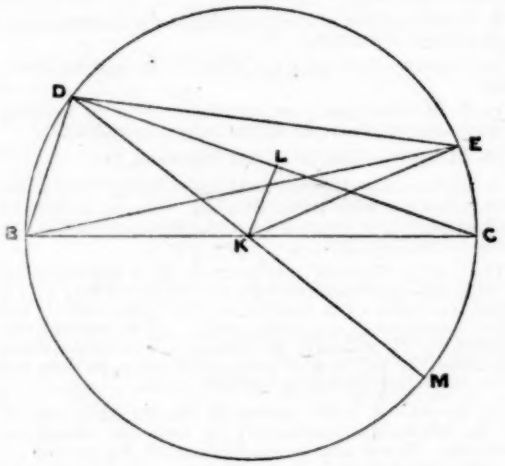
Again, since DG and BE are both at right angles to AC, they are parallel to one another;

Therefore the alternate angles GDE and DEB are equal to one another.

But FHD = GFE = GDE
and DCB = DEB
∴ GHD = DCB

and these are alternate angles, therefore FG is parallel to BC.
Q. E. D.

If we are limited to the First Book, as 'D. U.' believes, we should first have to show that, If from the middle point of the side opposite the right angle in a right-angled triangle a straight line be drawn to the right angle, it is = half the side opposite the right angle, thus:—



DBC (the letters corresponding to those in the previous figure) is a right-angled triangle, right-angled at D. Let K be the middle point of BC, then KD shall be equal to KB or KC.

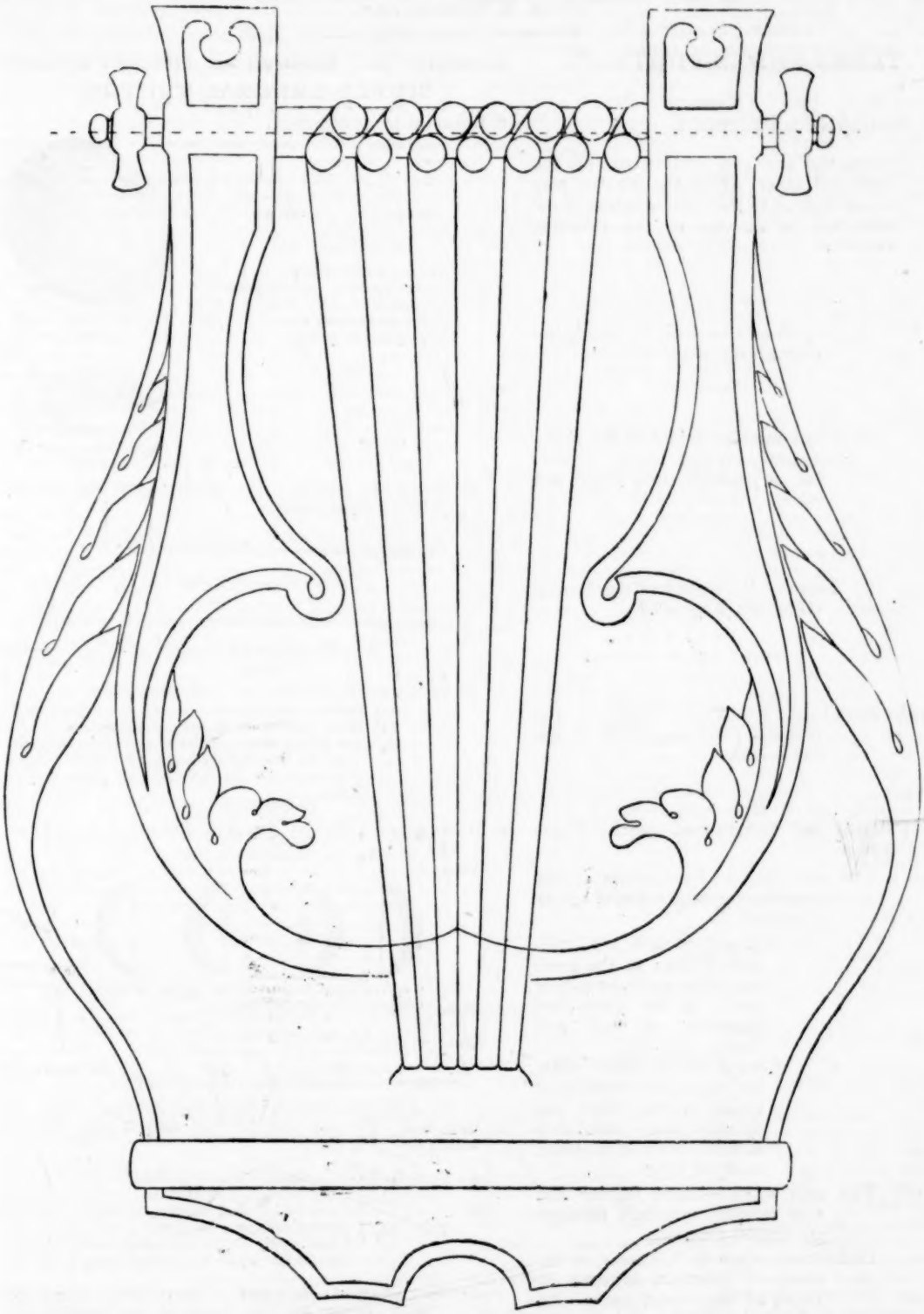
Bisect DC in L and join KL, BL.
Because DL = LC,
Therefore the triangle KDL = triangle KCL,
And because BK = KC,
Therefore the triangle KBL is also = triangle KCL.
Therefore the triangle KDL = triangle KBL.
But these are on the same base KL.
Therefore KL is parallel to DB,
and therefore KL is at right angles to DC.
But since LD = LC, and LK is common to the two triangles KLD and KLC, and the angles at L are right angles,
Therefore KD = KC or KB.
Similarly BEC is a right-angled triangle on the same base BC, and KE can be proved = KC or KB.
Hence KB, KD, KE and KC are all equal, and a circle drawn with centre K at the distance of any one of them would pass through the ends of the other three.
Produce DK to meet circumference in M.
Since the angle KDE = angle KED, and the exterior angle EKM is = the two angles KDE and KED,
Therefore KDE is = half the angle EKM.
Similarly CDK can be proved to be = half the angle CKM,
Therefore the remaining angle EDC is = half the angle EKC.
But the angle EBK is also = half the angle EKC.
∴ EDC is = EBC.
Similarly we could draw a circle round FDEG (previous figure) and show GFE = GDE, and proceed as before without assuming any knowledge of the Third Book.

33. ALDYTH.—The papers on Physiology will shortly be continued in the PRACTICAL TEACHER.

34. INQUISITIVE.—Write to Messrs. Crosby Lockwood and Co., Stationers' Hall Court, who are the publishers of De Fivas French works.

35. ATHOS.—Thanks; you are quite right.

Freehand Drawing Copy. By W. H. Harvey, B.A. (Lond.).



HARP COPIED FROM AN OLD COIN.

Notes of a Lesson—Elementary Notions of a Fraction.

BY JOS. H. COWHAM, F.G.S,
Westminster Training College.

TERMS AND DEFINITIONS.

1. Notion of a Fragment.

From the examples enumerated on the right, and others which the scholars may be encouraged to state, the attention of the class will be directed to the following TRUTHS.

(*a*) Objects may be made to assume the fragmentary form.

(*b*) When an object is broken, the pieces are scarcely ever regular in size, but they assume many shapes and sizes.

(*c*) **Term**:—Each piece of the broken object is a *fragment.*

Definition:—A FRAGMENT is one of the irregular parts into which an object is broken.

2. Fragments contrasted with Fractions.

THE NEW IDEA to be conveyed by the examples opposite is that of EQUAL DIVISIONS.

N.B.—Fragments are common forms: in the roadway there are fragments of rock; in the house are fragments of food and clothing and fuel.

Contrasted with these irregular fragments are pieces of entire objects which are obtained after careful division by means of measure, scale, or tape.

THE NEW NAME.—These regular and very carefully measured divisions are termed Fractions.

Definition—(not the full notion of the term)—**a fraction is one or more of the equal parts into which an entire object may be divided.**

Examples and Illustrations arranged to teach SIMPLE GENERAL TRUTHS.

1. EXAMPLES TO BE OBSERVED.

(*a*) Teacher shows an apple fresh from the garden, and contrasts its entire and single condition with the fragmentary state of an apple prepared for pastry.

Fig. 1.—Apple fresh pulled.

Fig. 2.—In pieces for pastry.

(*b*) Show a stick complete. Then break a similar stick into any three unequal pieces.

A school-pointer; whole.

A similar pointer; in three pieces.
Fig. 3.

(*c*) Other examples from experience—memory exercise.

(1) The new jug in place of one smashed into pieces.
(2) Sheep grazing changed to joints in a shop.
(3) Ask class to name similar changes from the entire to the fragmentary state, and direct special attention to the fact that the pieces vary in size.

2. EXAMPLES OF CONTRAST BETWEEN FRAGMENT AND FRACTION:—

(*a*)

Fig. 4.—Four equal divisions of the apple. Contrast these with the fragments in the dish (Fig. 2).

(*b*)

A yard measure divided into three equal divisions. Contrast these equal parts with the three unequal pieces of broken stick (Fig. 3).

(*c*) Examples from experience—memory exercise:—

(1) Journey to school 3 equal miles.
(2) An acre field divided into 4 equal roods.
(3) A quart of milk into two pints.
(4) Scholars supply similar examples of entire objects divided into equal or fractional parts.

(*d*) TEST EXAMPLE:—Give strips of paper to each scholar in the class. Require one strip to be torn into fragments, and another to be divided into 2, 4, and 8 equal parts. Now supply the term and ask for its definition.

Publications Reviewed.

First Year of Scientific Knowledge. By Paul Bert. Relfe Brothers.

This is a most remarkable book. We have no hesitation in saying it is one of the most remarkable books ever written on scientific knowledge for children. In three years no less than 500,000 copies have been sold in France. It is adopted in the *ecoles primaires* by children between the ages of eleven and thirteen. These children are expected, in a year or so, to have notions sufficiently accurate on the subjects which it contains, having been prepared for it by a more elementary study of the same subjects from the age of nine to eleven. We have learned from the highest authority that the book has been used for several years with great success, not only in France, but in Belgium, where it has been included, by special order, on the list of classical books for public schools. Translations of it are also in use in Russia, Norway, and Italy.

On opening this book for the first time one is simply filled with wonder and admiration. A closer examination only deepens these impressions. Whether we consider the masterly manner in which the subjects have been selected, the fascinating way in which they have been presented, the neatness and novelty of many of the experiments, or the number and artistic beauty of the illustrations, we are forced to admit that nothing at all equal to this has ever been put within the reach of the English scholar.

We need not here insist on the glaring defects of English books. The teacher has often to choose between cheap and small books, which are inaccurate, and large and expensive ones which are beyond the capacities of the children. There is, also, very frequently an attempt at over-simplification. A point too difficult to be understood when correctly stated is misstated in order to make it easier. The pupil has then, at some future time, to unlearn what he has been taught before he can make true progress.

But the child who reads this book will have nothing to unlearn. His information on many points will be small, but it will be sound so far as it goes. Let us take the question of the production of heat in the human body, and see how the author deals with it.

'I have already told you that blood circulates all through the body. (1) It must therefore pass through the lungs, and it circulates at such a rate that all the blood of the body passes through these organs in about half a minute. (2) Until lately it was thought that the oxygen of the air consumed the materials of blood during its passage through the lungs, and that the furnace that keeps up our heat was situated in that particular place. (3) But it was clear that if all the heat of the body originated in that spot the lungs would inevitably have been cooked—nay, even reduced to ashes. (4) Subsequently, it was ascertained that when the blood issues forth from the lungs it is cooler than when it enters them; whilst, evidently, the contrary would have been the result had the internal fire been in the lungs. The production of heat takes place in a very curious manner. You remember I told you that there exist in the blood quantities of very red bodies or corpuscles, to which blood owes its rich red colour. (5) Well, these corpuscles, on passing through the lungs, lay hold of the oxygen of the air and carry it along with them. Thence they penetrate into the utmost recesses of the body, even into the capillary vessels; and, in the course of their journey, yield up and transfer to the organs through which they pass a considerable portion of the oxygen they possessed, for which these organs have greater need and affinity than even the corpuscles themselves. (6) So it is all through the body that the consumption of oxygen takes place, and consequently the production of heat likewise takes place all through the body.'

There is the same happy combination of clearness and accuracy all through the book. Phenomena which are often thought to be beyond the capacities of children are explained in quite a simple manner, and frequently illustrated by effective and original experiments.

We have spoken of the illustrations. But they must be seen to be fully appreciated. They are as numerous as they are beautiful. And there is nothing among our ordinary school-books to compare them with. This is a matter which affects English publishers; for now we have seen what the artist is doing for our neighbours, we shall not be slow to ask why he should not do as much for ourselves.

It is said that there is scarcely a French village where this book is not in use. We can hardly expect that it will be universally adopted in the primary schools of this country. Special courses of instruction are laid down in the 4th schedule of the English Code of Regulations, and this book may contain both too much and too little. We have no hesitation, however, in saying it would be a good thing if it were universally adopted, especially if the information were conveyed as the author desires, and no examination held at the end of the year. It is the ever-present dread of examiners and their reports, and the foolish uses which stupid people make of them, that spoils the teaching, by checking the originality and independence of our teachers.

Scientific instruction in our primary schools will largely gain by every teacher obtaining a copy of this work at once. Nobody who buys the book will regret doing so. Indeed, teachers can scarcely be said to know how much science can be taught to children until they have studied M. Paul Bert's 'First Year of Scientific Knowledge.'

Murby's Scripture Manuals. The Epistle of St. James. By a Practical Teacher.

The object of these manuals is to assist candidates preparing for the Oxford and Cambridge Local Examinations. The writer tells us he has been accustomed to prepare notes for his pupils. He believes this little work will save much time and labour. We agree with him. Teachers and students will find this a short, handy, and trustworthy guide.

Commentaries for Bible Classes. The Gospel of St. Mark, with Introduction, Maps, and Notes. By T. M. Lindsay, D.D. Blackie and Co.

We have here ninety-six pages for fourpence, a marvel of cheapness. It is intended to be used in Bible-classes of senior scholars, and a most excellent text-book it would be for such classes. It is a really high-class manual, and aims at supplying such explanations as will enable the reader to understand difficult phrases and allusions.

The same author has prepared similar manuals for senior Sabbath scholars, on the Acts of the Apostles, Parts I. and II., of sixty-four pages each. They are on the same plan as the former. Dr. Lindsay believes that the great need of the day is to make our young people thoroughly acquainted with the Word of God itself, and hopes these little books will help earnest teachers who are impressed with the same thought. These books are admirably done, and we hope they will be very largely used. They only need to be seen and examined to be appreciated.

Frictional Electricity. By H. C. Tarn. London: W. and R. Chambers.

This is a manual of eighty pages, in paper cover, intended, like the preceding volume on magnetism, to meet the requirements of students reading for the elementary stage of the Science and Art Department, or the second-stage specific subject in the Mundella Code. It has been written, the author tells us, from notes of his lectures, with the view of making those points especially clear which are liable to be misunderstood by beginners. Candidates who present themselves in the elementary stage are not expected to show an acquaintance with numerical laws or methods of measurement. Units and quantitative statements are therefore excluded. We do not complain of this; but if the student has to begin the advanced stage by learning the C.G.S. system of units he has a hard year's work before him. Ere long it will be recognised

that one cannot easily learn physics without knowing that system, and the earlier children become acquainted with it the better.

The Oriel Readers. London: Marcus Ward and Co.

This series of reading books commences with three infant primers of forty-eight pages each. They are beautifully printed and bound, and have capital illustrations, several of them very prettily coloured. We may be sure these pictures will be dear to the little folks who use these books. The lessons are suitable, and carefully graduated. The children are expected, we presume, to learn to read on the 'Look and Say' method. Some attempt is made to use different consonants with the same vowel-sounds, not so much as we should like to see, but that is a matter upon which opinions differ. But opinions can hardly differ as to the inexpediency of using two sounds of the vowel 'o' in the third lesson, where we find no, go, so, to. Similarly, in the 15th Lesson we have 'but' and 'put' close together. These conjunctions may be accidental. New combinations of letters appear to be brought in quite promiscuously; indeed, the writer seems to have written amusing and useful sentences, and then tabulated the words; he did not select the words and then make what sentences he could out of them. The primers are sure to be favourites. They will be highly appreciated both by teachers and scholars.

The Third Standard. Pp. 192.

This is a well-printed and attractively-bound book. The lessons are suitable, and judiciously selected. At the end of the lessons there is some instruction in grammar, together with exercises upon it. There are also special pieces for dictation. There is no table of contents. The poetical selections are at the end of the book. The names of the authors of the pieces are not given. The illustrations are very fair.

The Fourth Standard. Pp. 224.

The same plan is pursued. Grammar and dictation follow the reading lesson. The pieces selected are certainly very readable and interesting. The poetical extracts are of a higher type, and the names of the authors are appended in most cases.

The Fifth Standard. Pp. 240.

The prose pieces are excellent. The names of authors are given, but not the names of the works whence the extracts are taken. A table of contents, with this information added, would certainly increase the value of the book. Many a young pupil would like to know more of Tita and Bell, after he had read of the 'Night on Grasmere,' and would be on the look-out for more rills from 'The Town Pump.' The passages have certainly been chosen with great taste and judgment. They will be eagerly read, and at the same time serve as models of pure English. Whole pages might be learned by heart with advantage. We are sorry we cannot praise the illustrations; they are decidedly weak.

Twelve Lessons in Model Drawing. By William C. Thirde, Head Master of the Elgin School of Art.

A page of introductory matter precedes the twelve lessons in this little pamphlet. The rules of perspective which apply to model drawing are given, but little use is made of them in the lessons which follow. Mr. Thirde says that these rules should be learnt. We quite agree with him, but we go a step further and say that model drawing can only be really successfully taught when these rules are also consistently applied. The plan adopted is that of simple measurement by means of the pencil held at arm's length, and lengths and distances are determined by comparison. The only guide-lines which are used are either vertical or horizontal, and the pupil thus practically ignores the rules of perspective which he has been expected to commit to memory. Notwithstanding this criticism, we think Mr. Thirde has done well in publishing his lessons. They embrace all the principles connected with rectilineal figures and solids, straight-edged or curved. The introduction of drawing among the class subjects will lead to inquiry for text-books on the subject, and, in conjunction with the lessons now running through the PRACTICAL TEACHER, this little book would be a help to all teachers who have to teach this, the most difficult and yet most useful branch of the subject.

Scott's Lady of the Lake: 307 lines from Canto I. With Life and Notes. London: W. and R. Chambers.

Much of Scott's poetry is well suited for awaking or training in children a taste for healthy literature. While it does not make too great a demand on their understanding it appeals to their imagination and stimulates a proper curiosity. This description applies specially to this selection, which tells briefly the Story of the Chase, and leaves the young student just when Ellen comes on the scene. The notes are abundant and clear, and include many derivations as well as simply expressed meanings. The latter may indeed seem to be in some cases superfluous; though here and there a desirable explanation is wanting. Thus, if it is necessary to explain 'dale' and 'wild heaths,' the word 'moss,' for swampy ground, should be explained; and the uncommon expression, 'Woe worth the chase, woe worth the day,' seems worth more than the bare paraphrase, 'I wish the day and the chase had never come.' The life of Scott is brief, simple, and interesting; and a clear little map of the Trossachs and surrounding country serves to illustrate the story of the chase.

Reprints of English Classics: The Task Book I. By William Cowper. With Life and Notes. London: W. and R. Chambers.

The verse of Cowper is varied, pleasing, playful, and didactic, and the first book of 'The Task' affords an excellent example of his literary style. This style is rightly characterised in the compact sketch of Cowper's life which appears as an introduction to this edition as 'clear, flowing, and natural.' The work of the editor appears to have been done very carefully. The many words of Latin origin, which render some passages weighty and sonorous, and others gently ironical, are well explained for the student, the elliptical and inverted constructions, which add so much variety to the versification, are neatly and simply paraphrased, or otherwise made easy for the young reader, and the abundant allusions are commented on in a manner at once adequate and not redundant.

The Lay of the Last Minstrel. By Sir Walter Scott. With Life and Notes. London: W. and R. Chambers.

Sir Walter Scott's first great work is here presented in a very pleasing and useful edition. The poem is one which affords abundant opportunity for historical annotation, and for the explanation of terms and the elucidation of manners belonging to the military and monastic life of mediæval times; and in this volume the editor has not neglected the opportunities afforded by the work, for the notes on the incidents, the language, and allusions are very full and very many. Indeed they seem to be rather more numerous than is needful, for many explanations are repeated; the following terms and phrases among others being explained more than once, on different pages 'buckler,' 'falchion,' 'warders,' 'St. Michael's Night,' 'Yarrow's streams,' 'baldric,' 'amice,' 'despite,' 'dubbed a knight,' 'Dunedin.' If the same expression occurs a second time in the same sense, it seems only reasonable that some trust should be placed in the reader's memory, or, at least, that a reference to the former note should suffice. The biographical sketch and the introduction to the poem are written in an interesting style, and the book is well adapted for reading in the upper classes of elementary schools, and for introduction into libraries for young people.

Shakespeare's King Richard II. With Introduction, Story of Play, Notes, etc. By John W. Allen. London: Longmans, Green, and Co.

'King Richard II.' is one of those historical plays most suitable for selection to be read and studied in the upper standards of elementary schools, as required by the new Code. This edition, marked as it is by the features which make the different volumes of Longmans' Modern Series so acceptable, contains everything that should be necessary to lead the more advanced school children to an intelligent appreciation and enjoyment of the substance, the incidents, and the language of the play. The introduction opens with a short and well-written sketch of Shakespeare's life, which is followed by sections on his writings, grammar, and versification, the latter compiled with due reference to Dr. Abbott's standard work on Shakespearian grammar. About a dozen pages are occupied with the story of the play, extracted from Holinshed's History, the source from which Shakespeare drew the materials for the foundation of the drama. The glossarial notes and explanations of historical and other allusions are brief and pointed, and afford just the kind of help that is needed, not to supersede but to stimulate thought, not to deaden but to quicken interest. Thirty examination papers follow the notes, and supply an almost exhaustive set of tests of the results of studying the book. An appendix on 'Word-building,' which has, we believe, done duty in other volumes of the series, makes the volume complete as a means of meeting the special requirements of the Code in 'English.' Altogether, we can recommend this work as maintaining the high character already gained by previous volumes of the series.

Vere Foster's Copy Books; Nos. 16 and 17. London: Blackie and Son.

Vere Foster's Copy Books have now been before the public many years, and their reputation is fully established; but we venture to think that these two numbers will be appreciated more than either of the others. The same principle has guided the writer as in the earlier numbers, but the writing is bolder, more upright, and more distinct; while the condensed and the expanded styles are suitable for the official writing which needs to adapt itself to both requirements, as space permits. They are well-named 'Civil Service Handwriting,' and a youth leaving school, with this plain, clear style well-developed, may be sure of acceptance as a clerk—other things being equal.

Laurie's Kensington Test Cards. Standards III—VII. London: Thomas Laurie, 31, Paternoster Row.

Each packet of these test cards contains thirty cards and a paper of answers. Many of the Third Standard examples show great similarity of construction, but those of the other packets are considerably varied. Great want of care has been manifested in reading the proof sheets, for many of the cards are imperfectly printed, letters being wanting in many places; and in the Fifth, Sixth, and Seventh Standards it is impossible to read a large number of the fractions. This, however, is not the worst feature of the cards. In seven or eight cases there are sentences without verbs, while in others the sentences are either incorrectly or badly expressed. Especially is this the case with the Seventh Standard, in which there is scarcely a card which has not some fault, or in which there is not some wrong answer. We have marked twenty-five out of the thirty cards—fourteen for giving incorrect answers (and we have by no means worked all the examples), and the rest for faulty construction, misspelling, or other similar reason. On card 6, for example, we read of 'interest being charged at 3 per cent.,' and the sum is one in discount. On card 9 we are told 'a train leaves *both* places'; and in sum 3, the emptying pipe of a cistern does less than the filling pipes, and yet the question is asked, 'When will the *rank* (tank) be empty?' Card 16 is imperfect, only a part of sum No. 4 appearing on it. Card 17, sum 2 is very badly expressed, if the answer is to be accepted as correct. On card 18 we have the expression 'been on,' for 'been at work,' and the same card asks 'what fraction?' when a mixed number is the answer. On card 24, interest is again put for discount. And so we might go on.

We have tested only a few of the questions on the other cards, and yet have found mistakes in them. The packet for Standard VI. contains several imperfect cards, and some very badly printed fractions; while the fractions in Standard V. nearly all go beyond the requirements of the Code, and the bills of parcels are nearly all problems and not plain straightforward questions. In fact, the majority of the questions in all the cards are expressed as problems. This may be of service in testing the intelligence of a class, but fails to give a chance to those children who have had great difficulty in mastering the bare mechanical part of the work. The cards need revision, better printing, and correct answers, before we can recommend them for adoption by our readers.

The Acme Drawing Cards. First Grade Freehand, Set A. By James Wadey. London: Thomas Murby, 3, Ludgate Circus.

This is a packet of cards of the same size as the ordinary test cards, each card containing the same pair of designs. Five other sets are published. The author states that they are the outcome of practical experience in teaching drawing, in which he has been very successful. By using the cards, all the class can be employed upon the same copy at the same time, and thus faults of construction and method may be pointed out to a whole class. The copies are, however, very small, and it will be necessary for the pupil to learn to enlarge at the same time as to make the form. To get proper proportions is the most difficult task for a pupil, especially if he has not an exact copy to follow, and we are of opinion that this must militate to a considerable extent against the value of the small cards. The copies are beautifully printed on good cardboard.

History of Scotland. By Francis Watt, M.A. Edinburgh and London: W. and R. Chambers.

Mr. Watt has produced a practical, readable history of Scotland for use as a history and reading book in the Fourth Standard of the Scotch Code. The lists of words and meanings are very full, and the summary of events complete. The book is got up in Messrs. Chambers' usual style, and forms a serviceable and valuable addition to their long list of acceptable schoolbooks. No Scotch boy can read it without having the national feeling intensified, although it is eminently free from partisan language, and English pupil-teachers might do worse than get it, to obtain a concise knowledge of the events of Scottish history previous to the accession of the Stuarts.

Selections from the Arabian Nights. By George C. Baskett. London: George Bell and Son, York Street, Covent Garden.

Messrs. Bell and Son have issued this book as one of their series of Reading Books. Teachers must use their own judgment, founded upon actual acquaintance with the "Arabian Nights," as to the suitability of introducing such a work into their schools as an ordinary Reader. The compiler of this selection admits that in these tales moral or didactic teaching is entirely absent, and that in them fancy reigns supreme. In our opinion, however interesting they may be, it is certainly not desirable that a book of this kind should be the staple of a boy's reading for a whole year. So far as is possible, the most unsuitable passages have been omitted, and the selection has been judiciously made. The stories included are those entitled, 'The Story of the Ass and the Ox;' 'The Merchant and the Genie;' 'The Fisherman and the Genie;' 'Sinbad the Sailor;' 'The Little Hunchback;' 'Aladdin, or the Wonderful Lamp;' 'Aladdin and Fatima;' 'Ali Baba

and the Forty Thieves;' and 'The Enchanted Horse.' The book might very well be admitted into the school library in preference to the full edition of the 'Arabian Nights.' It is well printed, and has several illustrations.

The Drill Arithmetic. London: W. and R. Chambers.

The preface to this work says that one of its chief features is an attempt to teach vulgar fractions at a much earlier stage than is usually done, and 'in such an easy and progressive manner as to demand scarcely any greater effort than what is required to master the difficulties of the four simple rules.'

The method adopted is to teach the various processes of addition, etc., of fractions with the same denominators immediately after teaching the addition, etc., of integers. Then the method of reducing fractions to their lowest terms, and performing the various processes, is taught in the usual way. For practical use in schools examined under the Code, we fail to see the value of the book. As an educational and scientific method of treatment, however, it is worthy of praise. The book derives its name from a few pages of tables intended to obtain rapidity in the mental performance of the First Four Rules.

Map-Drawing Copies. London: Blackie and Son.

These Map-Drawing Copies have been issued in three separate parts for Standards III. and IV., V., and VI. and VII., and also bound together for all the standards named.

Each part contains eight or nine selected maps, printed quarto size, in a bold outline, with physical features well defined and printing easily imitated. Mercator's projection has been used throughout. The maps are not crowded with names, the selection having, in most cases, been suitably made. They are intended for use as home or school copies for imitation, and having seen them in actual use, we can safely say that they assist greatly in securing clearness of outline, and commendable accuracy and neatness of execution. They are good and cheap.

(*a*) **Philip's Grammar School Atlas.** I. and II., for Preparatory Classes.

(*b*) **Atlas for Standard VII.** London and Liverpool: George Philip and Son.

There can be no excuse for the neglect of teaching geography in grammar or other schools on the score of want of suitable text-books or atlases. Messrs. Philip and Son have just published, in a handy small octavo form, two remarkably cheap atlases for preparatory classes. One contains fifteen, and the other thirty-one full-coloured maps. The maps are very clear, not too crowded with names, and yet containing those of the chief physical and political features of the world. Lines of latitude and longitude are, we think, unwisely dispensed with, the numbers only being printed in the margins.

The atlas for Standard VII. is most suitable, and contains all that is required in the way of maps and diagrams for this increasingly important standard. With oral lessons, the geography for the Code, and much beyond it, might be learnt from this atlas.

Cassell's Readable Readers. First and Second Infant Readers, and First to Sixth Reading Books for Standards I. to VI. Cassell and Company, Limited.

It may be laid down as a general principle that children will most easily learn to read with intelligence and expression, if the subject-matter of their reading lessons be of an interesting character such as young minds can appreciate and enjoy. This principle has been well observed throughout by the compilers of this new series of reading books. It is this feature which constitutes the chief merit of the series, and establishes its claim to its distinctive title.

The First Infant Reader begins with the alphabet and the shortest words, which are soon made into childish narratives, with a thread of interest running through them. In this book the type is remarkably clear and large, so that young eyes need not be overstrained, and so, in another sense, the book may be called *readable*.

The Second Infant Reader contains a number of the short stories and poems that little children delight in, such as 'The Old Woman and Her Pig,' and 'Three Little Kittens,' with others more novel, and equally interesting.

In the reading books for the standards the plan is adopted of giving continuous stories, divided into short chapters or lessons. Thus in the First Standard book we find 'Topsy,' a story of a pony as told by itself, in ten chapters; 'The Tinder Box,' a fairy story, in eleven parts; and 'Charlie Gay,' a story of life in India, in thirteen parts. These tales in prose are relieved by nearly a score of simple poems, by authors who have been most successful in writing poetry for young children—Mrs. Alexander, Mrs. Hawtrey, Mrs. Craik, W. Allingham, R. L. Stevenson, G. Macdonald, and others. The second book contains three stories similarly subdivided, adapted to children rather more advanced, and in like manner having poetical pieces interspersed.

The plan of preserving continuity in the lessons is followed in the higher books, and the selections are very carefully graduated so as to suit the various standards. In the third and fourth books such favourite authors as Miss Mitford, Miss Edgeworth, Miss Havergal, H. C. Andersen, W. H. Kingston, and Lord Brabourne are laid under contribution, and the poetry includes many well-known English lyrics.

In the fifth and sixth books the lessons are of rather more substantial character than in the earlier volumes, but they still consist, for the most part, of bright and spirited narrative, and include Washington Irving's 'Rip Van Winkle,' 'The Cruise of the Dolphin,' by T. B. Aldrich, passages from Scott, Smiles, Froude, from Kinglake's 'Eothen,' the Earl of Dunraven's 'Great Divide,' and some very fresh and interesting chapters on English literature, entitled 'Shakspere's Life,' 'The Vicar of Wakefield,' 'Gulliver's Travels,' and 'The Legends of King Arthur,' by Mrs. Buckland. The poetry includes some of the favourite pieces from Byron, Scott, Longfellow, and scenes from Shakspere; but there is a considerable proportion of less known poems by more recent writers, as Trench, M. Arnold, and Lewis Morris. Explanatory notes and short biographical sketches of the authors are placed at the end of these two volumes. It almost goes without saying that a new set of reading books for the standards is carefully adapted to the latest requirements of the Education Department; but it gives us pleasure to add that the bright, attractive qualities of the 'Readable Readers' must tend to correct, or at least to relieve, the monotonous mechanical modes of teaching which, rightly or wrongly, are thought by many to be necessary to meet the Code requirements.

All the volumes of the series are well printed, well bound, and well illustrated; and they are published at very moderate prices. It appears to us a fault worth remedying that in some of the volumes the conclusion of the last lesson is printed on the inside of the cover.

Murby's Scripture Manuals. The Epistle to the Philippians. By a Practical Teacher. London: Thomas Murby.

This little manual is 'intended for the use of students preparing for Oxford and Cambridge Local and other examinations.' From a short preface, which contains some valuable hints as to the way in which a book of Scripture should be studied so as to master it, we gather that the writer offers these notes as affording to the student such help in study as he would be able to obtain from the reading of large and important books, if they were within his reach. The introduction explains the circumstances under which the Epistle was written, and describes its general character and purpose. A life of St. Paul follows, with a section on the points in which this Epistle

is autobiographical. Then we have a brief summary of the whole, a summary of each chapter, biographical, geographical, and explanatory notes. The latter, we observe, give the new readings of the Revised Version. The short biographies are necessary to a full understanding of the Epistle, and they increase the interest of the student. A page of questions for test examinations is appended. The book is compact, and likely to prove very useful if the suggestions of the preface are followed.

Occupations and Occupation Games for Infant Classes. By Jas. Singleton. London: Jarrold and Sons.

The British Association had recently under consideration the desirability of teaching the facts of geography by means of puzzles and games. Considerable differences of opinion, and not a little ridicule, appear to have been provoked by the novel proposal. It was feared the union of the names of English counties with the divisions required for a game at '*hop-scotch*' would degrade those venerable and honoured terms. To some geographers this would be an act not less villainous than that of the hardened wretch who dared to speak disrespectfully of the equator. 'Much may be said on both sides.' Games have their place in all systems of education. The proverb 'All work and no play makes Jack a dull boy' rests on a considerable substratum of truth. On the other hand, an education received mainly through the medium of regulated play would scarcely be worth the name. Safety rests somewhere between these extremes. In early training, whilst mind is mainly in contact with the concrete or the facts of the world around it, the value of games is at a maximum; as mind develops and the reasoning powers become operative playful occupations and game lessons lose their value. A complete separation of study and play is demanded by the student youth. He refuses to join a game intended to teach a lesson, and ridicules a lesson degraded to the level of a game.

Mr. Singleton frequently sees little children at work in our infant schools; he evidently intends to make them happy in their work; he has laid intelligent hold of the sound principle that the infant mind becomes receptive when interest is aroused, and, further, that interest is awakened in the child's mind rather by novelty and charm in the object than by any effort of will on the part of the child.

The first portion of the book consists of simple occupations, sixteen in number, many of which may fairly claim originality. Valuable advice on the educational bearing of each exercise is given, and the expansion of the occupation to higher educational aims and results is indicated. The whole of this section of the book is admirably illustrated. The second part of the book gives, in letterpress only, the details of thirty-three carefully selected lesson-games. Some of these could be successfully performed only after much practice. A group of children able to act with precision Game 20—'The Storm'—would be an acquisition to any evening entertainment. The next game, under the direction of a bright and sympathetic teacher, would soon place the alphabet securely in infant minds. Teachers of infant schools and classes will find in this book much help in their attempts to occupy and amuse their little ones. At the same time, the systematic arrangement of very simple material here displayed will suggest modes of making use of other familiar objects for purposes of instruction, both in the home and school.

Philip's Standard Map Drawing Book. Part I.: England and Wales. London and Liverpool: George Philip and Sons. Price 3d.

Here are three sketch maps, with corresponding blank projections for pen-and-ink copy of each. The idea is not new; the selection of matter is excellent, but the representation of Salisbury Plain, Exmoor, and Dartmoor, by a thick black line suggestive of a mountain-chain is misleading. The maps and blank projections are admirably executed.

Scientific Romances. No. II. 'The Persian King; or, the Law of the Valley.' C. H. Hinton, B.A. Swan Sonnenschein.

A little while ago Mr. Hinton wrote a charming little romance, called 'What is the Fourth Dimension?' Those who read it were struck with its novelty and clearness, and felt perhaps very much as Socrates says he did after listening to the eloquence of Protagoras—as if he would like to pause before making a reply.

The present pamphlet will be found equally fascinating and equally subtle. We will not promise that all who are pleased with the 'Persian King' and his strange adventures will comprehend the 'Law of the Valley.' Indeed, we can only say to those who read the first romance, be sure to read the second.

Natural History Plates. Edinburgh and London: W. and A. K. Johnston.

These are capital productions, and being well printed and serviceably mounted are likely to prove most useful for class work. The drawing and general delineation of the animals represented deserve commendation. It is unnecessary to enlarge on the aid pictorial illustrations lend to the teacher's efforts: that aid is unquestionable. It will suffice to say that those examples of the above series of plates which have come under our notice are very true to nature in detail and colouring, and that the particulars printed at the bottom of each plate contain just that information, in connection with the habits and economic value of the creature delineated, which is necessary for school use.

Johnston's Illustrations of Natural Philosophy: Chemistry, No. 3, Combustion. Edinburgh and London: W. and A. K. Johnston.

We have pleasure in directing the attention of teachers to this really capital sheet of diagrams, and to the little explanatory hand-book which accompanies it. Of course in science-teaching recourse should be had as far as possible to actual experiments, for nothing impresses so firmly on youthful minds the why and wherefore of a fact as the actual working through step by step under their very eyes of the whole performance. In some cases, however, circumstances may forbid the appeal to actual experiment; and in those cases the teacher could desire no better assistance than that afforded by this wall sheet. The illustrations are effective in colouring and clear in drawing, and will prove equally suitable when used as subsidiary to actual experiments, or in the entire absence of such.

The Infant Action-Song and Recitation Book. Parts I., II., and III. London: J. Marshall and Co., Paternoster Row.

An excellent collection of songs and recitations suitable for infant schools or nurseries. Parts I. and II. contain both songs with music (melodies only) and recitations, while Part III. consists entirely of the latter.

Many familiar nursery rhymes and dialogues are inserted, in addition to a large number of new and interesting pieces. The selection has been made with taste and judgment, and we feel sure that infant teachers who need songs and recitations, either for school inspections or school festivals, will welcome this collection, which, as the title-page informs us, is the work of an experienced teacher. Each part contains fifty pieces; and the language and sentiments are adapted to the capacity and intelligence of young children. The music is simple, and, generally speaking, *within the compass of baby voices.* This is a great desideratum in school music, for we would have all teachers, remember that to strain unduly the voices of children of tender years is not only a great mistake, but often a serious evil. *Infant teachers should avoid all songs which range above D, or, at most, E flat.* No. 8, a round, contains (probably through a printer's error) some bad harmony which should be corrected in the next edition.

Song Book for Infants. Edited by Mrs. Carey Brock. London: National Society's Depository, Westminster.

This book contains twenty-four songs, mostly original, with pianoforte accompaniment; and will be found very useful in schools where part-singing is attempted. The words and music are chaste and refined, and it is needless to say that the general get-up of the book is all that could be desired. Some of the pieces are, however, beyond the capacity of infant schools, and would be more suitable for the higher standards, and for those children who have had considerable practice and training in singing.

Wall Map of India. London and Edinburgh: W. and A. K. Johnston.

Of a handy size, two feet nine inches, by two feet three inches, carefully printed in clearly defined colours, and not overcrowded with names, this map seems very suitable for school use; and the more so since its moderate price brings it within the reach of all. The names inserted are, as a rule, judiciously selected: one omission, however, and that a regrettable one, struck our notice—namely, the Khyber Pass. The Bolan Pass is marked, so why the better known Khyber should be omitted is only to be explained as an oversight.

While on the subject of maps, we may as well say that school maps are not even yet up to the standard we should like to see. They deal, as a rule, too much with political geography, and too little with physical; and in system of colouring and scope of information afforded, seem to be tied down too much, we fancy, to the style of ten or fifteen years ago to be quite as they should. It must be understood that we are now simply alluding to the maps usually issued for school use, and are not dealing with special productions issued at prices which prohibit their utilisation for general educational purposes. If the two divisions of physical and political geography could be combined a little more on the same map, and the nature of the land surface, as well as the political divisions, shown by characteristic colouring, a step would, we think, be made in the right direction. If, too, a slight advance were made in the scope of information given—if, for instance, the nearly blank expanse of sea-surface could be utilised for giving information respecting the depth of water, the fisheries carried on, the chief sub-oceanic cable communications and well-known postal and trade routes; if celebrated harbours and anchorages and some notable lighthouses (in addition to the Eddystone) could be marked; and some distinction afforded to towns and districts of any special importance, as manufacturing centres, dockyards, garrison or fortified towns, universities, etc., we are convinced the study of geography would be considerably benefited.

To carry out these points would, we are aware, entail considerable expense, and necessitate most careful and judicious discrimination in the colours and methods employed; but we think that even if absolute perfection could not be attained, the present state of lithography and its sister arts is fully equal to effecting a marked improvement in modern school cartography.

The Minerva Drawing Examples for Class Teaching. By W. McDougle. London: A. Johnston and Co.

This capital and cheap series consists of twenty sheets comprising one hundred and twenty-five well-drawn and systematically arranged examples. Each sheet contains one large copy drawn with thick black lines, and several smaller ones, following, as far as possible, the same guide lines. Used in conjunction with black-board teaching, the employment of the series can hardly fail to give excellent results. The objects represented are of a simple and everyday nature, and both the graduation of the drawings, and the neat and effective style in which they have been brought out, deserve warm commendation.

PRIZE BOOKS.

Messrs. Blackie and Co.'s List.

First Notice.

Five excellent books for boys and girls have reached us from Messrs. Blackie and Co. They are all got up in good style, well illustrated, printed on capital paper, and very strikingly bound.

Silver Mill. By Mrs. R. H. Read.

A very interesting book; it will be a great favourite with girls of fifteen or sixteen. The morals are taught quietly; there are none of the preachings which, no doubt are well-intentioned, but, we have noticed, are generally skipped by our merry maidens. When they want a tale they like to have one, not a volume of sermons in slight disguise. 'Silver Mill' is a real tale, just after their own hearts; but parents also will gladly welcome a book that must influence their girls on the side of truth, honesty, and unselfishness. Ruth and Amos are very real and very lovable, their faults are so natural; they are not too good. We can strongly recommend 'Silver Mill.'

Patience Wins; or, War in the Works. By G. Manville Fenn.

This is a genuine boys' book, but the story of the conflict between the masters and the workmen is so exciting and interesting that we must confess we could hardly put the book down until we had reached the end. The adventures of Jacob and his uncles are many and various. They are determined to use in their works a superior kind of steel which they had invented, and the men, backed by the Trades Union, were equally determined to keep to the old style. The savage and brutal outrages committed by the men are borne with admirable patience, and at last the masters gain the confidence of their people, and all ends well. An admirable prize-book for boys. It is printed on excellent paper, and the illustrations are meant to catch a boy's eye.

The Lion of the North. By G. A. Henty.

Another of Mr. Henty's historical tales. Any boy reading it cannot fail to acquire a good knowledge of the Thirty Years' War and its famous actors. Malcolm Græme, though only a boy, enlists under the flag of Gustavus, and by his bravery soon draws upon himself the notice of the king. His coolness, courage, and hairbreadth escapes lend life to the historical details of this fearful war. The death of Gustavus and the murder of Wallenstein are ably treated, and the differences of opinion concerning these events are touched upon. The book is of considerable length, 382 pages, well printed on good paper, the illustrations very fair, and the binding very attractive.

Famous Discoveries by Land and Sea, and Stirring Events of History.

We have classed these two books together, as they are much in the same style. They dwell on passages in history which are sure to arrest the attention of children, and therefore would serve well as reading books. 'Famous Discoveries' relates the discovery of the New World by Columbus; the conquest of Mexico by Cortez, and of Peru by Pizarro; the discovery of Canada by the noble, though less known, Jacques Cartier; Raleigh's adventures in Guiana, when in search of El Dorado and the golden city of Manoa; how Don Ferdinando de Soto conquered Florida, and other striking deeds of famous men. The subjects in 'Stirring Events of History' are too numerous to be mentioned, but they will bear out the title of the book. The Death-toilette, an incident in the French Revolution, and episodes of the Indian Mutiny, are almost too horrible to relate to children. With these exceptions, we think the subjects are well selected and ably treated.

Messrs. Hodder and Stoughton's Publications.

First Notice.

From the Tan-yard to the White House. By W. M. Thayer.

This life of General Grant is designed as a companion-volume to the author's life of President Garfield, which was exceedingly popular, more than a quarter of a million copies having been sold. The author is fortunate in his subject. The history of General Grant's career is one of absorbing interest. At the age of thirty he was struggling to support his family in a village on £160 a-year. He lived to become a great soldier and an illustrious President. We have no doubt but that this book will be a favourite. The life of Grant abounds in stirring incidents, and these are excellently related. The author has written this book with a definite and noble end in view. He seeks to stimulate and instruct his readers by the study of the life of one who 'was born of common people, lived with them, fought for them, presided over them, and never rose above them in his heart.' It is an excellent book, and very tastefully bound. Indeed, the same may be said of all three of the books sent to us; they are most attractive in appearance.

For James or George. A Schoolboy's Tale of 1745. By H. C. Adams, M.A.

This is a goodly volume of 407 pages, but we are sure its boy-readers will not wish one page curtailed. It gives us some curious glances of schoolboy life a hundred and forty years ago; and Mr. Adams, in his preface, vouches for the accuracy of the portraits he has drawn. The tale is founded on the melancholy history of Prince Charles Edward's invasion of England—Hugh de Clifford, the hero, siding with the Jacobites, and his rival, John Warton, with the Hanoverians. How they both fared in the struggle, and the happy issue, we leave our boys to find out for themselves.

Nigel Lennox of Glen Irvine. By L. N. Hyder.

Is suited to girls just growing into womanhood, who would do well to imitate Agatha's self-sacrificing, industrious life. Her character was made complete by coming under the influence of Nigel's world-wide charity. This book points out a mistake so often made by earnest Christians, especially young ones: they throw themselves with ardour into parish or other benevolent works, overlooking the duty that is nearest—making their own home happier. If Agatha had shown more loving sympathy with her sister and family, she might have done as noble a work in raising them to a higher life as ever she did in Crook's Peak. 'Home missions' are as important as 'foreign missions.'

Messrs. Nelson and Sons' Prizes.

First Notice.

The outside appearance of these books—an important element, we presume, in the matter of prizes—is all that the prize-giver or receiver could possibly expect, or even wish for; and so good is the paper and printing that it is quite a pleasure to read them, irrespective of their contents.

Some of them are illustrated, but of the illustrations we shall speak in detail as we notice them separately.

(1) **Thankful Rest: a Tale.** By Annie S. Swan.

This is an American tale of two children who were left orphans and sent to the tender mercies of an uncle and aunt, who, at the beginning of the book, are described as being as surly and as disagreeable as they could possibly be, but who, under the never-failing influence of gently-born and bred children, gradually change and become nearly all that one could wish them to be. Some of the Americanisms will somewhat jar on the ears of the English reader; otherwise the book is prettily and graphically written.

(2) **Egypt, Past and Present.** Described and Illustrated by W. H. Davenport Adams.

To this book there are no less than 100 illustrations, of which the frontispiece is a fair portrait of the martyr-hero Gordon, and on the title-page there is inserted a picture of Khartoum. The other pictures are quite up to the average of the pictures one generally finds in books of this class.

The work is intended to instruct more than to amuse, and begins with a description of Egypt's boundaries, soil, and divisions. A reference is made in the preface to its undoubted prosperity and advancement in the patriarchal times, of which we read in the Bible; and this fact alone, the author thinks, ought to direct attention to the country.

In the first chapter we were struck with a passage showing how unchanged this land of Egypt is, with its—above all—wonderful river, just as of yore; with its almost uninjured Pyramids and, perhaps, most wonderful of all, its scarcely modified language. Its people, too, seem to have the same idiosyncrasies that they had, and its place in the history of the world is strangely similar now to what it has ever been.

The book is wonderfully full of information—too full, perhaps, for a book to be enjoyed by the young—which is made as interesting as the subject will allow.

For a thoughtful, information-loving boy or girl, it would be doubtless more prized than a mere story, which would only bear one reading, or, at the most, two.

(3) **At the Pastor's.** By the Author of 'The Swedish Twins,' etc.

The title-page bears the following text as a motto: 'When my father and my mother forsake me, then the Lord will take me up.' We are not, therefore, surprised to find that the story consists of a small child being taken care of by the good pastor of the village, on—or more strictly, at—the approaching death of the little one's mother. The story is laid in Sweden; but Swedish women of the better sort seem to be very much like English and American and other women. And of the good pastor we could happily find many a counterpart in our own land. The interest in the child is increased by its being blind. At the end of the book she discovers that she has an exceptional voice for singing. Some neighbouring count, who had found her when straying, and so got to know and take an interest in her, gets her lessons; and in doing good, gets good for himself; and out of gratitude founds a small blind asylum, with which several of the characters in the story have to do, more or less. The book is pretty, and suitable for young children.

(4) **Story of the Red Cross Knight.** From Spenser's 'Fairie Queen.' By R. A. Y.

This is an attempt, and by no means an unsuccessful one, to do with Spenser what Charles Lamb and his sister have done so well with Shakspere. Here is the old story of the Red Cross Knight and Una told in simple prose to children, and greatly, we feel assured, will they enjoy it.

Some of the illustrations are in outline, and decidedly artistic. We strongly recommend the little volume, and hope the adapter may be led to take up another portion of the poem and treat it in the same way.

(5) **Seeking a Country; or, The Home of the Pilgrims.** By Rev. E. N. Hoare.

Here is another old—we may almost say, immortal—story told once more. As long as the world lasts it will

know of the *Mayflower* and her band of faithful men seeking a new home where they could worship as they felt they ought.

The author tells us this is a fiction founded on fact, some of the characters, names, and all being creations of his own brain. At the same time, he has tried to represent what actually did take place, and has added, in notes and appendices, the accounts of things which are accounted as historically true, and which he has not woven into his story.

A considerable portion of the book is taken up with arranging and preparing to embark for the new home, and the book has been more than half read before we find our heroes on the other side of the Atlantic.

Doubtless, many readers of this book will naturally turn to Longfellow's poem on the hero Standish. The illustrations are quite up to the mark, and help to beautify an already very pretty volume.

(6) **Thoughts of Sunset.** Illuminated by L. M. W.

This is an exquisite little volume, beautifully and brilliantly illuminated on every other page, the remaining pages being occupied by appropriate hymns, of about sixteen lines each. Every illumination contains the setting sun.

There is an illuminated text and a hymn for every evening in the month, the former of which a child could, with great advantage, commit to memory.

We are glad to see the name of the authors of the hymns appended to each hymn, and that the compiler has not hesitated to insert some by that king of hymn-writers, Faber.

———o———

The 'Practical Teacher' Sale and Exchange Column.

Owing to numerous requests, we have been induced to start this Exchange Column for the benefit of our readers. We shall be glad to insert announcements relating to the 'Sale or Exchange' of books, etc., at the rate of ONE PENNY PER LINE, *prepaid.*

For Sale or Exchange, good as new:—Sheets V. and VI. Johnston's Diagrams ('Physiology') for 5s. each, published at 10s. 6d. each. 'Agriculture' (Wrightson) for 1s., published at 2s. 'Physiology' (Angell) for 9d., published at 1s. 6d. 'Magnetism and Electricity' (Guthrie) for 1s. 6d., published at 3s. 'Agriculture' (Tanner) for 2s., published at 3s. 6d. 'Botany' (Balfour) for 6d., published at 1s. Wanted, Cassell's 'British Butterflies."—Master, National School, Newbury.

At one-third published price:—
Charmell's Natural Philosophy, 4s.
Todhunter's Mechanics, 4s. 6d.
1st B.A. Mathematical Books. (List stamp.)
Herodoti Historia (Oxford), 3s.
Homeri Odyssea (Oxford), 3s.
Student's Guide to Cambridge, 5s.
Intermediate Arts Guide to Study in Mathematics, 3d.
And (nett):—
Bradley's Lessons in Latin Prose, 1s. Exercises, 1s.
Hughes' Modern Geography, 1s. 6d.
Book Guide for 1st B.A. Mathematics, 2d.
1st B.Sc. Mathematical Guide, 2d.
Or lot sent for 10s. paid.—1st B.A., 1, Little Templar St., Leeds.

Green's Hist. English People. 4 vols., 8vo, cl., 1877-80. 42s.
" Making of England. 8vo, cl., 1881. 10s. 6d.
Social Life in Reign of Queen Anne. 2 vols., 8vo, cl., 1882. 8s. 6d. [copy, circa 1839. 23s.

The Wilkie Gallery, with engravings complete. Folio, cl., good
Vocal Melodies of Scotland (full music size), piano accom. by Finlay Dun and J. Thomson. 4 vols., cl., 1836-40. Good copy (pub. 60s.), for 21s.—Address, J. Scouller, School House, Duns, Berwickshire, N.B.

For Sale:—Smith's 'Initia Græca,' Pt. II., 2s. 6d.; Beeton's Classical Dict., 9d. (new); Chambers's German Dict., 2s. 6d.; Liddell and Scott's Greek Lexicon, 3s.; Madvig's Latin Gram., 4s. (new); Arnold's Lat. Prose Comp., 2s. 6d.; James's German Dict. (new), 3s. No cards.—James Cameron, British Schools, Wylam-on-Tyne.

Dr. Smith's Smaller Greek Grammar (as new). 1s. 9d.
Key to Cæsar, Books I.-VII. 1s. 3d.
Erckmann-Chatrian's 'Romans Populaire,' containing about 34 tales, etc., large and well bound, and equal to new. 6s.
Racine's Works. 2 vols., calf. 1s.
Address—Alpha, 27 Dover Road, Folkestone.

Wanted:—1st copy of 1st vol. (March, 1881), and 1st copy of 4th vol. (March, 1884) of the PRACTICAL TEACHER. 2s. or 2s. 6d. offered for pair in fair condition.
December, 1884, for Sale.
Address—J. Lethbridge, 9, Amity Place, Plymouth.

For Sale:—First 4 volumes of the PRACTICAL TEACHER, together or separately.
Address—Mr. Sales, Board Schools, Bungay.

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Extracts from the Report of the Committee

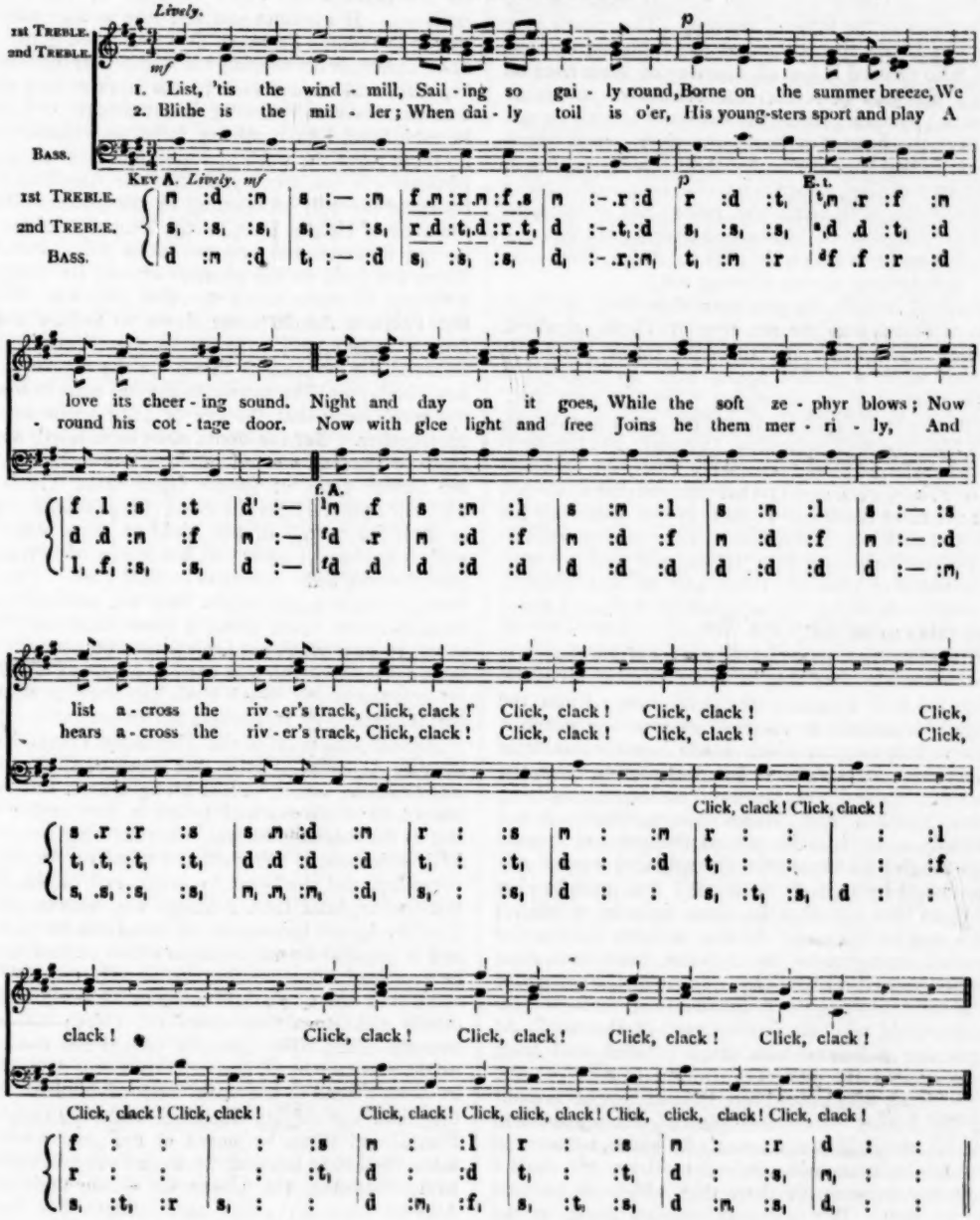
Appointed for the Purpose of Continuing the Inquiries Relating to the Teaching of Science in Elementary Schools.

THE principal duty of your Committee is to watch the course of legislative action as far as it has any bearing on the teaching of science in elementary schools; and naturally the annual modifications of the Educational Code claim the first consideration. This year, however, these modifications have been exceedingly small, and there is but one which affects the teaching of science, and that only indirectly.

The revised instructions to Her Majesty's Inspectors, issued this year, contain the following additional clauses on geography, which meet with your Committee's entire approval:—'Geographical teaching is sometimes too much restricted to the pointing out of places on a map, and to the enumeration of such details as the names of rivers, towns, capes, and political divisions. It is hardly necessary to say that geography, if taught to good purpose, includes also a description of the physical aspects of the countries, and seeks to establish some associations between the names of places and those historical, social, or industrial facts which alone make the names of places worth remembering. It is especially desirable in your examination of the Fourth and higher Standards that attention should be called to the English colonies and their productions, government, and resources, and to those climatic and other conditions which render our distant possessions suitable fields for emigration and for honourable enterprise.'

The Committee awaited the appearance of the second report of the Royal Commissioners on Technical Instruction, and at the meeting at Montreal merely expressed a thorough approval of the recommendations of the said Commissioners:—'That proficiency in the use of tools for working in wood and iron be paid for as a specific subject, arrangements being made for the work being done, so far as practicable, out of school hours. That special grants be made to schools in aid of collections of natural objects, casts, drawings, etc., suitable for school museums.'

Last February, however, your Committee reported to the Council that they did consider it desirable to make representations to the Education Department, and suggested that the encouragement for the teaching of handicraft might take the form of that recommended by the Royal Commissioners on Technical Instruction; or that 'the use of tools' in boys schools might be placed in the same position as 'practical cookery' in girls' schools. The Council received the report, but did not see their way to proceed further in the matter.

THE WINDMILL.

Lively.
1st Treble.
2nd Treble.
Bass.
1. List, 'tis the wind - mill, Sail - ing so gai - ly round, Borne on the summer breeze, We
2. Blithe is the mil - ler; When dai - ly toil is o'er, His young-sters sport and play A
Key A. Lively. mf
love its cheer - ing sound. Night and day on it goes, While the soft ze - phyr blows; Now
round his cot - tage door. Now with glee light and free Joins he them mer - ri - ly, And
f. A.
list a - cross the riv - er's track, Click, clack! Click, clack! Click, clack! Click,
hears a - cross the riv - er's track, Click, clack! Click, clack! Click, clack! Click,
Click, clack! Click, clack!
clack! Click, clack! Click, clack! Click, clack! Click, clack!
Click, clack! Click, clack! Click, clack! Click, click, clack! Click, click, clack! Click, clack!

Popular Mythology.

BY THE REV. SIR GEORGE W. COX, BART., M.A.,
Author of 'Tales of Ancient Greece,' 'Mythology of the Aryan Nations,' etc.

[These papers are designed for our youngest readers. Used as themes for composition work, they will be found invaluable.]

ACHERON, in Greek mythology, was the name of one of the rivers in the infernal regions. The others were known as Lethe, the stream of forgetfulness, because those who crossed it lost all memory of their lives on earth; Kokytos (Cocytus) the stream of mourning and woe; Pyriphlegethon, the stream of blazing flame; and Styx, the hateful or loathsome river, across which Charon ferried the dead. As these names explained their own meaning, Acheron was also supposed to mean a river flowing with aches and pains; but in all likelihood the kingdom of Hades had at first only this one river, the name of which is akin to Axios, Exe, Esk, Usk, and denotes simply running water.

Achilleus, Achilles, the great hero of the Iliad, is called a son of Peleus and the sea nymph Thetis, at whose marriage Eris, the spirit of strife, threw upon the banquet table a golden apple, with an inscription which marked it as belonging 'To the most fair.' The prize was claimed by the three great goddesses, Hêrê, Athênê, and Aphroditê (Venus); and the decision was referred to the tribunal of Paris, the beautiful son of Priam, who, lured by her promise that he should have the most beautiful woman in the world as his wife, awarded it to Aphroditê. The promise was fulfilled when Paris stole away Helen, and bore her with her treasures to Ilion (or Troy), and so was kindled the great strife which the weapons of Achilleus alone could bring to an end.

Dipped by his mother in the stream of the Styx, the babe became invulnerable in every part of his body, except the heel by which she held him. From the fire-god Hephaistos he received armour and weapons of marvellous temper, which made him irresistable in battle; and for steeds to his war-chariot, Zeus, the father of gods and men, bestowed on him the undying horses Xanthos and Balios (the golden and the speckled), which had the gifts of thought and speech. From the first he knew that his splendid career was to be closed by an early death, and the great burden laid upon him was that he must fight in a quarrel which was not his own. In that conflict he was the mightiest champion of the Achaian host, until Agamemnon roused his wrath by insisting on the surrender of the maiden Briseis. Achilleus then made a vow that he would take no further part in the war. At length the Achaians were hard pressed, and their misery excited the pity of Patroklos (Patroclus) the hero's friend, who prayed him to lend him his armour and his horses. Achilleus granted his prayer, and bade his myrmidons make ready for battle, but warned him that he must not venture to drive his chariot along any other path than that which he pointed out to him. But although, carried along in the full tide of victory, he smote down the Lykian chief Sarpêdon, he disregarded the warning, as Phaëthon forgot the warning of Helios. Patroklos died beneath the sword of Hektor, who stripped him of his armour, while the immortal horses wept for his fall. To Achilleus this disaster was a black cloud of sorrow. The nymphs rose from the sea to comfort him; but he brooded only on awful vengeance. The life-blood of twelve Trojans should flow, he said, on the funeral pyre of Patroklos. The wrong done by Agamemnon was atoned by the restoration of Briseis; and Achilleus could now prepare himself for his mighty task, by donning the new armour wrought for him by the fire-god Hephaistos and brought to him by his mother Thetis. As he put it on, a glorious light flashed up to heaven, and the earth laughed at the dazzling radiance. His helmet glittered like a star, and each hair in the plume gleamed like burnished gold. But as he mounted his chariot, his horse Xanthos bowed his head, and warned him of the approaching doom. The hero took the warning in good part. 'I know,' he said, 'that I shall see my father and mother again no more; but the work of vengeance must be accomplished.' It was accomplished when Achilleus thrust his spear through an opening in the plates which left the neck of Hektor bare, for the Trojan chief was clad in the impenetrable armour taken from Patroklos. Tying the body to his chariot wheels, he dragged it furiously, till none could say that this was Hector; but Phœbus Apollo came down to restore it to its former beauty, and to guard it from decay. Then followed the embassy of Priam for the recovery of his son's body, and the sorrow of the old man so touched the hero's heart that the cry of their mourning went up together. But the doom must be fulfilled, and the spear of Phœbus pierced the heart of Achilleus, near the Skaian gates of Ilion. Once more Thetis rose with her nymphs from the coral caves beneath the sea, to wash the corpse of her child in pure water, and wrap it in shining robes At last it was laid on a great pile of wood, and consumed in the flames. The ashes were placed in a golden urn with the ashes of Patroklos, and over it was raised a great cairn on the sea-shore, to be a memorial for all coming generations of the mighty hero who had left his home in Phthia to revenge the wrong which Paris had done to Menelaos by the stealing of Helen and her treasures.

Admetos, the chief of the Thessalian Pherai, had for his wife Alkestis (Alcestis), the fairest of all the daughters of Pelias, whom he had brought from Iolkos on a chariot, to which he had yoked a lion and a boar. But at the marriage festival, when the wine was poured forth in honour of the gods, the name of Artemis was forgotten, and she swore to bring evil on his house. But one mightier than Artemis was near to aid him. Phœbus Apollo himself was a bondman in his house, and in requital for the kindness which he had received he promised Admetos that he should not die if he could find one who would suffer in his stead. Soon a deadly sickness struck down the chief; but as his strength ebbed away Alkestis prayed that the burden might pass to herself, and so she went down in her husband's stead to the dark land of Hades. But at this time the mighty Herakles came journeying to Pherai, and when he heard of the grief which had made the house desolate, he went forth and did battle with Thanatos, the power of death, and rescued Alkestis from his grasp, and brought her back to Admetos in all the fulness of her life and beauty.

Adonis.—A Greek form of the Semitic word, Adonai, lord. In Greek mythology, Adonis was the child of the myrrh-tree. Charmed with the beauty of the babe, Aphrodite placed it in a chest and gave it into the charge of Persephone, the queen of the unseen land. But Persephone refused to yield it up when summoned to do so, and Zeus decided the matter by

declaring that Adonis should spend four months of each year with Persephone, four with Aphrodite, and four where he himself might please. These four he chose to spend with Aphrodite, whose darling he became; but a boar which he was chasing turned upon him, and Adonis died from the wound made by his tusk. Still, every year Adonis came back from the kingdom of Hades to gladden the goddess of love and beauty.

Æneas (Aineias).—Son of Anchises and Aphrodite, and, according to Virgil, the founder of the Roman people. Like Achilleus, who acknowledged him in the Trojan war as an opponent worthy of himself, he was the lord of undying horses. Virgil tells the tale that when Troy was burnt Æneas escaped with his wife Creusa, who disappeared in the confusion; that he went to Carthage, where he obtained the love of Dido, the queen; and that thence he made his way to Italy, and built a new Troy in Latium, where he won the friendship of the king Latinus, and married his daughter Lavinia. Some said that he fell in battle against the Rutulians; others that he plunged into the river Numicius, and passed to the company of the gods.

Ægis.—The Ægis is generally spoken of as the shield of Zeus, who often lends it to Hêrê, Athênê, and other deities. It is said to strike terror into all beholders, and in truth none might look upon it and live, for in the midst of the shield was the face of the Gorgon Medusa, whose head Perseus struck off with his sword. The mistake of the later Greek artists who supposed it to be a shield is easily accounted for. The Greek word 'Aigis' means a goatskin, and so they thought that the Aigis, or Ægis, was a shield formed of goat's hide. But the word may also be referred to a verb which implies violent and impetuous motion; and in the 'Iliad' it is always described as a be-fringed and be-tasselled garment worn over the shoulders. It darkens the heavens, spreading dismay everywhere. The origin of the notion is clear. Zeus, Hêrê, and Athênê are deities of the bright heaven; and the dismal storm-cloud, hurrying across it, is the garment of darkness, which strikes fear into the hearts of the bravest. The origin and meaning of the Gorgon myth we shall see when we come to deal with the story of Perseus.

Æsir.—In the mythology of northern Europe, the Æsir are the gods of the upper air or heaven, and answer to the Asuras of ancient Hindu tradition. The word denotes simply 'beings,' or 'those who breathe and live.' The abode of the Æsir was called Asgard, into which rose the branches of the world-tree Yggdrasil, the support of the universe. This tree had its roots in Niflheim, the land of mist and darkness beneath the earth, over which ruled the goddess Hel. Its trunk passed through Midgard, the abode of mortal men. The middle air between that which men breathe and that in which the Æsir dwell was called Vanaheim, or the home of the Vanir, the spirits of the moving winds.

Æther.—The Greek mythology, like that of northern Europe, represented the gods as dwelling in the pure, unsullied Ether of the high heaven, far above the murky Aêr, or Air, in which men have their abode. With them the land of darkness beneath the earth was the domain, not of Hel, but of Hades and his wife Persephonê (Proserpine).

(To be continued.)

Science Notes.

THE standard of white light which we have long been accustomed to is that given by a spermaceti candle weighing the sixth of a pound and burning at the rate of 120 grains per hour. Dissatisfaction has long been felt with this standard. A committee of the British Association for the Promotion of Science has come to the conclusion that the candle defined is not in any sense a standard. The spermaceti used is not a definite chemical compound, and the wick is not properly defined. The committee have come to the conclusion that, for commercial purposes, the pentane standard of Mr. Vernon Harcourt is the best. But, for scientific purposes, a definition in terms of energy was deemed necessary, as the eye cannot be used as an accurate instrument. By white light we may understand such light as we have in ordinary daylight.

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MANY of our readers will be interested to know what is the pentane or petroleum standard? It is now eight years or more since Mr. Vernon Harcourt described how a flame of constant intensity could be obtained by burning a mixture of air and petroleum vapour. The burner is such that the height of the flame can be adjusted. But the height of the flame depends upon the proportion in which the air and heavy vapour are mixed; more pentane vapour gives a longer flame, less a shorter one. Thus, to each height of flame there corresponds a certain mixture of air and vapour. The standard mixture gives the standard flame, and this is obtained by mixing three cubic feet of air and 1·05 cubic feet of vapour obtained from 9 cubic inches of petroleum. This, then, is the new standard of white light for commercial purposes.

***

SIR JOHN LUBBOCK told his audience at Birmingham on Thursday, the 1st, that the national necessity for science was most imperative. Even now we required to purchase food to the amount of £150,000,000 a year. A century hence our coal would be approaching exhaustion, our population would be trebled, and we should require, to speak moderately, £400,000,000 to pay for food. Nothing but the development of scientific training and appliances would enable us under these circumstances to maintain our population in happiness and comfort. We had, in fact, the choice between science and suffering. We hope the time is not far distant when managers of elementary schools will be allowed full liberty of choice in the matter of special subjects. At present the teaching of elementary science is virtually excluded from many of our country schools. When we find that every child in the French primary schools receives such instruction in common things as is contained in M. Paul Bert's "First Year of Scientific Knowledge," it is high time that the teaching of elementary science should be encouraged in every possible way.

***

IT has long been known that a very useful kind of gas can be manufactured by passing steam over heated coke. It consists chiefly of hydrogen and carbon monoside. The latter is exceedingly poisonous. If the mixture, together with steam, be sent through a red hot tube, the steam is decomposed; its oxygen

converting the carbon monoxide into carbon dioxide, which can then be fixed by passing the gases through lime water. The result is a gas of great heating power, admirably adapted for fuel-cooking purposes. This water gas, as it is called, gives scarcely any light. To render it serviceable for illumination, it can be passed through benzene or some similar liquid. The result is an exceedingly steady and intense flame. It is believed that great economy can be effected by the use of water gas.

***

THE Sanitary Institute has lately held its annual congress at Leicester. Among the subjects discussed, none was of greater importance than that relating to the provision of dwellings for working men. It is becoming more and more common to rear enormous piles of buildings to accommodate large numbers of human beings. Mr. Gordon Smith drew attention to the fact that the infantile death-rate in these blocks was excessive. He points out that ample open space about dwellings is of the utmost importance, especially in the interests of children, who are particularly sensitive to impure air. The removal of refuse and decaying vegetable matter should always be insisted upon. Whatever tends to render the air impure is bad, and worst of all for children.

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THE question of how to deal with sewage is becoming more and more important. Evidence of the danger of pouring it into rivers is constantly accumulating. Mr. J. J. Coleman has quite recently obtained results, which go to prove that putrefaction is a preliminary to oxidation in all cases of natural river purification. There must, therefore, be a dangerous stage between pollution and purification, and as fresh material is contantly being added, it is plain to see that we can never be safe. Sewage is useful on the land. It is both useless and dangerous everywhere else.

Publications Received.

Blackie and Son—

Maudie and Bertie. By Gregson Gow.
Holidays at Sunnycroft. By Annie S. Swan.
Worthy of Trust. By H. B Mackenzie
Phil Foster. By J. Lockhart.
Wild Marsh Marigold. By Darby Dale.
Kitty's Cousin. By Miss Mackenzie.
Little Dolly Forbes. By Miss Fenn.
A Year with Nellie. By Miss Fenn.
Cleared at Last. By Julia Goddard.
Fanny's King. By Darby Dale.
A Little Adventurer. By Gregson Gow.
Two Little Brothers. By M. H. M. Capes.
Tom Watkin's Mistake. By Emma Leslie.
Three Little Ones. By C. Langton.
Olive Mount. By A. S. Fenn.
Famous Discoveries by Land and Sea.
Silver Mill. By Mrs. R. H. Read.
Gulliver's Travels. By J. Swift, D.D.
Stirring Events of History.
Patience Wins. By George Manville Fenn.
The Lion of the North. By G. A. Henty.
Marie's Home. By Mrs. Austin.
Gytha's Message. By Emma Leslie.
Yarns on the Beach. By G. A. Henty.
The Search for the Talisman. By H. Frith.
For Name and Fame; or, Through Afghan Passes. By G. A. Henty.
Two Thousand Years Ago. By Prof. A. J. Church.
Outlines of Natural Philosophy. By J. D. Everett, D.C.L., F.R.S.
Book-keeping by Double Entry. By David Tolmie.
A Concise Dictionary of the English Language. By Charles Annandale, M.A., LL.D.
Vere Foster's Copy Books. Nos. 16 and 17 (Civil Service Handwriting).

Chapman and Hall, Limited—

Written Designs. By T. R. Ablett.

Cassell and Co., Limited—

The Commentary for Schools: Genesis. Edited by C. J. Ellicott, D.D.

Curwen (J.) and Sons—

Santa Claus at the School (Staff Notation). By W. H. Doane.

Chambers (W. and R.)—

Scott's Lady of the Lake (with Life and Notes).
The Task. Book I. By Cowper (with Life and Notes).
History of Scotland. By F. Watt, M.A.
Scott's Lay of the Last Minstrel (with Life and Notes).
The Drill Arithmetic.

Hodder and Stoughton—

For James or George. By the Rev. H. C. Adams, M.A.
Nigel Lennox of Glen Irvine. By L. N. Hyder.
From the Tan-Yard to the White House. By W. H. Thayer.
The Will Power. By J. Milner Fothergill, M.D.
Prudence Winterburn. By Sarah Doudney.
From Pole to Pole. By Gordon Stables, M.D., R.N.

Heywood (John)—

Examples of Machine Construction and Drawing. By T. Jones.
Exercises in Plane and Solid Geometry. Part I. By T. Jones.
Analysis of the Gospel of St. Matthew. By Lewis Hughes, B.A.

Jarrold and Sons—

Jarrold's Pictorial Alphabet Sheet.

Johnston (A.)—

Johnston's Object Lesson Pictures: Useful Vegetables—Potato, Pea, Cauliflower, Bean, Cabbage, Carrot, Turnip, and Onion.

Lewis (H. K.)—

Matriculation Questions on the English Language. By F. W. Levander, F.R.A.S.

Letts, Son and Co., Limited—

The Household Magazine. October.

Longmans and Co.—

Longman's Magazine. October.
Shakspere's Richard II. (with Notes, etc.).
Numerical Examples in Heat. By R. E. Day.

Murray, John—

The Eton Latin Grammar. Part I. } By A. C. Ainger, M.A.,
The Eton Latin Exercise Book } and H. G. Wintle, M.A.

Marcus Ward and Co., Limited—

The Oriel Readers. Standards IV. and V.

Nelson (T.) and Sons—

English, Parts 1 to 6.
Pocket Date Book of English History.
Thoughts for Sunset.
At the Pastor's.
Seeking a Country. By the Rev. E. H. Hoare.
The Story of the Red Cross Knight.
Egypt Past and Present. By W. H. Davenport Adams.
Thankful Rest. By A. S. Swan.

National Temperance Publication Depot—

Original Dialogues for Bands of Hope.

National Society's Depository—

Song Book for Infants. By Mrs. Carey Brock.

Philip (G.) and Son—

Philip's First School Atlas.

Relfe Bros.—

A Digest of English History (1760-1815). By M. Gutterbridge, B.A.

Smith, Elder and Co.—

The Cornhill Magazine. October.

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FIRST PAPER.

Three hours and a half allowed.

Euclid.

MALES.

All generally understood abbreviations for words may be used.]

(*Answer two questions, including No. 3, if you can.*)

1. In every triangle the square on the side subtending an acute angle is less than the squares on the sides containing the acute angle by twice the rectangle contained by either of these sides, and the straight line intercepted between the perpendicular let fall on it from the opposite angle and the acute angle.

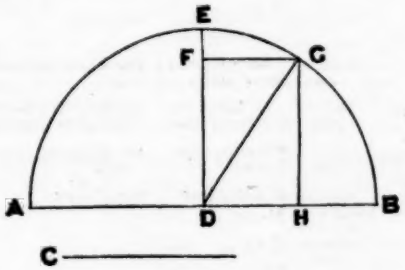
Euclid, Book II., Prop. 13.

2. If a straight line be bisected, and produced to any point, the squares on the whole line thus produced and on the part produced are together double of the squares on the line bisected and on the line made up of the half and the part produced.

Euclid, Book II., Prop. 10.

3. Divide a given straight line into two parts so that the rectangle contained by the two parts may be equal to the square described on a given straight line, which is less than half the straight line to be divided.

Let AB be a given straight line, and C a straight line less than half AB.



It is required to divide AB into two parts so that the rectangle contained by them may be equal to the sq. on C.

Bisect AB in D. From D draw DE at right angles to AB. On DE mark off DF equal to C. Through F draw FG parallel to DB, and through G draw GH parallel to FD. Then AB is divided into two parts as required at the point H. Join GD.

For GH=FD (I. 34), and FD=C (Constr.) ∴ GH=C.

And ∵ AB is divided into two equal parts at D, and two unequal parts at H, the rect. AH,HB together with the sq. on DH=sq. on DB (II. 5.)

And sqs. on DH,HD=sq. on DG (I. 47), which=DB. Take away sq. on DH.

Therefore rect. AH,HB=sq. on HG, *i.e.*, to sq. on C.

Q.E.D.

Algebra.

1. Find the value of $x^4-2a(a-b)x^2+(a^2+b^2)\ (a-b)x-a^2b^2$, when $a=1$, $b=-2$, $x=3$.

$$x^4-2a(a-b)x^2+(a^2+b^2)\ (a-b)x-a^2b^2$$
$$=81-2(1+2)9+(1+4)\ (1+2)3-4$$
$$=81-54+45-4$$
$$=68. \text{ Ans.}$$

2. Simplify :— $\dfrac{x+2}{2(x+1)}+\dfrac{2-x}{2(x-1)}-\dfrac{x}{x^2+1}$.

$$\frac{x+2}{2(x+1)}+\frac{2-x}{2(x-1)}-\frac{x}{x^2+1}$$
$$=\frac{(x+2)\ (x-1)+(2-x)\ (x+1)}{2(x^2-1)}-\frac{x}{x^2+1}$$
$$=\frac{x}{(x^2-1)}-\frac{x}{x^2+1}$$
$$=\frac{x(x^2+1)-x(x^2-1)}{(x^4-1)}$$
$$=\underline{\frac{2x}{x^4-1}}. \text{ Ans.}$$

3. Solve the equations :—

$$(a)\ \frac{x-7}{2}+\frac{x}{9}=\frac{x+7}{3}.$$
$$(b)\ (3x-5)\ (6x-7)-2(3x-5)^2=75.$$
$$(c)\ \frac{x}{a}+\frac{y}{b}=1.$$
$$\frac{x}{b}-\frac{y}{a}=1.$$

$$(1)\ \frac{x-7}{2}+\frac{x}{9}=\frac{x+7}{3}$$
$$9x-63+2x=6x+42$$
$$5x=105$$
$$x=\underline{21}. \text{ Ans.}$$

$$(b)\ (3x-5)\ (6x-7)-2(3x-5)^2=75$$
$$18x^2-51x+35-18x^2+60x-50=75$$
$$9x=90$$
$$x=\underline{10}. \text{ Ans.}$$

$$(c)\ \frac{x}{a}+\frac{y}{b}=1.$$
$$\frac{x}{b}-\frac{y}{a}=1.$$
$$bx+ay=ab$$
$$ax-by=ab$$
$$abx+a^2y=a^2b$$
$$abx-b^2y=ab^2$$
$$a^2y+b^2y=a^2b-ab^2$$
$$y=\frac{a^2b-ab^2}{a^2+b^2}=\underline{\frac{ab(a-b)}{a^2+b^2}}. \text{ Ans.}$$
$$b^2x+aby=ab^2$$
$$a^2x-aby=a^2b$$
$$(a^2+b^2)x=a^2b+ab^2$$
$$x=\frac{a^2b+ab^2}{a^2+b^2}=\underline{\frac{ab(a+b)}{a^2+b^2}}. \text{ Ans.}$$

Mensuration.

An elliptical plot of grass is 63 feet across in one direction, and 42 in another; find the distance round.

$$(63+42)\times 1{\cdot}5708$$
$$=105\times 1{\cdot}5708$$
$$=164{\cdot}934 \text{ ft.}$$
$$=\underline{54 \text{ yds. } 2{\cdot}934 \text{ ft.}} \text{ Ans.}$$

Arithmetic.

FEMALES.

1. At what rate per cent. will £5 amount to 5 guineas in 219 days?

5 guins. − £5 = 5s. int.
219 days : 365 days :: 5s. : $\underline{£8\frac{1}{4}}$. Ans.
£5 : £100

2. How much wine at 16s. 8d. per gallon must be mixed with wine at 25s. per gall. in order to have 250 galls at 19s. 2d.?

25s. − 19s. 2d. = 5s. 10d.
19s. 2d. − 16s. 8d. = 2s. 6d.

The amount lost on the 25s. wine is thus $\frac{7}{23}$ of that gained on the 16s. 8d. wine.

The proportions must then be 3 of the 25s. to 7 of the 16s. 8d.

$\therefore$ $\frac{3}{10}$ of 250 = 75 at 25s.

$\frac{7}{10}$ of 250 = 175 at 16s. 8d. Ans.

3. Find the discount on £237 10s. paid 2 years before due at 7 per cent. simple interest.

In 2 years £100 would make £14.

£114 : £14 :: £237 10s. : £29 3s. 4d. Ans.

4. Three men received £48 for work which had occupied one of them for 48, another for 108, and a third for 132 days? What ought each to receive?

48 + 108 + 132 = 288 days' work.

$\therefore$ Their shares would be

$\frac{48}{288}$ of £48 = £8
$\frac{108}{288}$ of £48 = £18
$\frac{132}{288}$ of £48 = £22
} Ans.

Grammar.

MALES AND FEMALES.

1. Analyse and paraphrase the following passage, and parse the words in italics:—

The worthy gentleman who has been snatched from us in the middle of the contest, *while* his desires were *as warm*, and his hopes as eager *as ours*, has feelingly told us *what shadows we are*, and what shadows we pursue.

ANALYSIS.

Sentence.	Kind of Sentence.	Connective.	Subject.	Predicate.	Object.	Exten. of Pred.
(*a*) The worthy gentleman has feelingly told us	Princ. Sent.		The worthy gentleman	has told	us	feelingly (manner
(*b*) who has been snatched from us in the middle of the contest	Adj. Sent to gentleman in (*a*)	*In rel.*	who	has been snatch'd		from us (place) in the middle of the contest (time)
(*c*) while his desires were as warm	Adv. to (*b*)	while	his desires	were as warm		
(*d*) and his hopes as eager	Adv. to (*b*)	and	his hopes	[were] as eager		
(*e*) as ours	Adv. to (*d*)	as	ours	[are eager]		
(*f*) what shadows we are	Nom. Snt. obj. to (*a*)		we	are what shadows		
(*g*) and w't shadows we pursue	Nom. Snt obj. to (*a*)	and	we	pursue	what shadows	

We have been told by the honourable gentleman who has so suddenly been removed from us in the midst of the conflict, whose wishes were as fervent, and whose expectations were as bright as our own, how frail we are, and how fleeting are the objects we pursue.

While—advl. conj., joining the sents., 'Who has been snatched' and 'His desires were as warm.'

as—adv. of deg., qualg. *warm*.

warm—adj. of quality, qualg. *desires*.

as—cop. conj., joining the sents., 'His hopes were as eager' and 'Ours are eager.'

ours—pers. pro., com. gen., plur., 1st, poss., gov. by 'hopes.'

or—poss. pro., plur., com. nom. to *are*.

what—rel. pro., used as adj., qualg. 'shadows.'

shadows—com. noun., neut., plur., nom. after *are*.

we—pers. pro., com., plur., 1st, nom. to *are*.

are—irreg. int. verb, act., ind., pres., 1st, plur., agreeing with *we*.

2. How do you account for the presence of many French words in the English language?

In 1066 England was invaded from Normandy, and the Norman kings, their nobles and soldiers, and a large body of churchmen who filled all the ecclesiastical offices, all spoke Norman-French, and all of whom were probably entirely ignorant of English. French, therefore, came to be used freely. The laws were written in French, the same language was used in the law courts, in the schools, and universities. It was at this time, therefore (1066—1400), that large numbers of French words were introduced into our language.

4. Give the derivation and meaning of the following words:—

Succession, sanctify, felicity, visible, derivation, conjugation, glorious, privacy.

Word.	Roots.	Prefixes and Affixes.	Meaning.
succession	*cedo*, to go	*sub*, under; *ion*, denoting action	Act of succeeding or following after.
sanctify	*sanctus*, holy; *facere*, to make		To make holy.
felicity	*felix*, happy	*-ty*, denoting abstract idea	Happiness.
visible	*video*, to see	*-ble*, possibility of action	That which can be seen.
derivation	*rivus*, a river	*de*, down; *ion*, denoting action	The act of deriving; tracing a word to its original root.
conjugation	*jungo*, to join	*con*, together *—ion*	Act of joining; inflection of verbs.
glorious	*gloria*, brightness; prob. from *clarus*, clear	*-ous*, full of	Full of glory.
privacy	*privo*, to separate	*-y*, state	State of being alone.

Geography.

(Answer two Questions, including No. 1.)

1. Draw a map of (*a*) the Mediterranean Sea and its connections, *or* (*b*) of the Pacific Ocean.

2. Give full notes of a lesson on 'Brazil.' Illustrate by a map.

1. *Situation, Size, and Boundaries.*—An extensive country of South America, stretching from 4° 30′ N. lat. to 33° 45′ S. lat., and from 34° 45′ E. long. to 72° E. long. Length (E. to W.), 2,600 miles; breadth (N. to S.), 2,450 miles; area, 3,280,000 square miles. Boundaries—N., by Colombia, Venezuela, Guiana, and the Atlantic; E., by Atlantic; S., by Uruguay; W., by Argentine Republic, Paraguay, Bolivia, and Ecuador.

Surface.—The N. and W. occupied by the immense plain of the Amazon and its tributaries, the E. has parallel mountain ranges, the chief of which is the Terra do Espanhazo, from 5,000 to 7,000 feet in height. The great feature of Brazil is the river Amazon, 4,400 miles long, with its tributaries, Madeira (1,800 miles), Purus, Araguay, Xingu, Topajos, and Tocantin. Discharges great volumes of water, and has immense width near mouth.

Climate.—Being chiefly in torrid zone, hot, and in plain of Amazon moist and unhealthy. On table-lands cooler and drier, and eastern part healthy and agreeable.

Productions.—Of considerable value. Forests of vast extent, yielding mahogany, rosewood, logwood, and hard wood—*braza* (hence name); coffee plant, sugar-cane, cotton plant, tobacco, wheat, rice, and maize easily cultivated. Cassava plant gives food to people. Immense herds of wild cattle roam on plains. The sloth, armadillo, anteater, and tapir are numerous. Alligators swarm in rivers. Diamond mines most productive in the world; gold, silver, copper, lead also found.

People.—Of Portuguese extraction and of Roman Catholic religion. Secured their independence in 1822, and are governed by a hereditary emperor, a senate, and a representative chamber. Pop., 10,000,000.

Divisions and Towns.—Into twenty provinces, many larger than Britain. Rio Janeiro, one of the largest towns of South America, on a good harbour; chief port. Balina, Pernambuco, and San Paulo are other towns.

3. Explain the terms *latitude*, *longitude*, *planet*, and *planetary system* as to a fourth standard class.

Latitude is distance north and south of the equator—a circle drawn round the middle of the earth midway between the poles. Circles are drawn at equal distances (called 'degrees') from each other, the distance from the equator to the poles being 90°. By means of these circles we can tell how far a place is north or south of the equator. But as every place on any one of the circles is the same number of degrees from the equator, in order to fix the exact spot, we use lines of longitude drawn at right angles to the equator, and passing through the poles.

Longitude.—Longitude is distance east or west of any given meridian. The equator is a great circle, and is divided into 360°. Each meridian cuts the equator and the other parallels of latitude, and we can thus tell not only how far north a place is from the equator, but also how far east or west on the parallel it is. The first meridian passes through Greenwich, and is marked 0.

Planet.—On watching the stars, it will be seen that nearly all of them always occupy the same relative positions towards each other, *i.e.*, they never move one among the other. There are a few, however, which do change their places, and these are called planets, from a word which means *to wander*.

Planetary system.—These planets all move round the sun, and the sun, with its attendant planets, is called the planetary system.

SECOND PAPER.

(Two hours and a half allowed.)

Needlework.

FEMALES.

(One hour is allowed for the exercise in Needlework.)

Arithmetic.

MALES.

1. An estate of 750 acres is burdened with a mortgage of £2,500, bearing 4 per cent. interest; the clear rental being £1,118 15s. Find the average rent per acre.

£2,500 × 4 ÷ 100 = £100 interest of mortgage.
£1,118 15s. + £100 = £1,218 15s. total rent.
£1,218 15s. ÷ 750 = £1 12s. 6d. per acre. Ans.

2. In a town of 15,000 electors, ·72 voted for one candidate, and ·125 voted for another, how many electors did not vote at all?

1 − (·72 + ·125) = 1 − ·845 = ·155
·155 of 15,000 = 2,325. Ans.

3. What is the rule for finding the percentage of gain or loss on any article? Find the gain or loss per cent. if eggs bought at 16 for 1s., are sold at 1s. 6d. a score.

Find the gain or loss on the amount expended. Then by proportion, find the gain or loss per £100.

As the amount expended is to £100, so is the gain or loss on amount expended to the gain or loss per cent.

16 eggs cost 1s., and are sold for
20 : 16 :: 1s. 6d. : 1⅕s.
∴ Gain on 1s. = ⅕s.
Gain per cent = 1s. : £100 :: ⅕s. : £20. Ans.

4. If the 3 per cents. be at 90½, what sum must be invested to secure an income of £340, after paying an income-tax of 7d. in the £? (Omit brokerage.)

£340 represents $\frac{239}{240}$ of actual income to be received for interest.

∴ Actual income = $\frac{240}{239} \times 340 = \frac{81600}{239}$
and money to invest =
$3 : \frac{81600}{239} :: 90\frac{1}{2} : £10,521\frac{7}{13}$. Ans.

History.

MALES AND FEMALES.

1. What social reforms were effected in the reign of George III.?

John Howard, of Bedford, succeeded by his undaunted perseverance and high-minded philanthropy, in effecting a great reform in the prisons of this and other countries. He visited the gaols and called the attention of Parliament to their condition.

The Slave trade was abolished through the exertions of Thomas Clarkson and William Wilberforce. Clarkson was a Quaker, and roused the feeling of the country against the traffic which was carried on between our colonies and Africa. Wilberforce seconded his efforts in Parliament.

The severity of the criminal law was considerably mitigated, and the punishment of death for minor offences done away through the exertions of Sir Samuel Romilly.

Great improvements were made in the methods of travelling, in the arts of industry, and gas was used for lighting purposes—the steam engine was invented, and the first steamer plied on the Clyde; small-pox was greatly diminished in intensity, through the discovery of vaccination.

2. What was the condition of religion during the time of the Commonwealth?

Toleration in religious matters so far as regarded dissenters was the policy adopted under Cromwell. Presbyterians and Independents equally held Church livings, and no opinions expressed by any of the sectaries were forbidden to be held or expressed so long as they were not inimical to his government. Among the sectaries were Anabaptists, Levellers, and 'Fifth-monarchy men,' the last of whom believed themselves called to prepare for the reign on earth of Christ's saints. The Quakers also flourished, and Jews were for the first time since their expulsion by Edward I. allowed to settle in the country. The Episcopalian clergy, however, were debarred from preaching, and Roman Catholics also were prohibited from celebrating their religious rites. The laws against them, however, were not rigorously enforced, and many of their congregations met in private.

3. What efforts were made to extend our colonies and to make discoveries during the reign of James I.?

The first permanent settlement of English in America was made by a London company of merchants, who founded James Town in Virginia. The first Puritans, driven from the coast of Norfolk to Holland, and thence compelled by their fear of absorption into the Dutch community, sailed in the *Mayflower* to America, and founded Plymouth, a town in New England. These were the first of the colonies which afterwards were united under the name of the United States. Further efforts were made to find a North-West passage. Henry Hudson explored Hudson's Bay in 1610, and was lost after being turned adrift by a mutinous crew. The coasts of America were still further explored by Thomas Button, Robert Bylot, and William Baffin, the latter of whom penetrated to the northern extremity of Baffin's Bay.

Teaching.

Write Notes of a Lesson on 'WEATHER.'

I. *Introduction.*—Refer to the kind of day on which lesson is being given. Compare with other days, and get as many varieties named as possible. How is it there is such a difference?

II. *Common and general causes of different kinds of weather.*

(1) Situated in temperate zone. (2) Time of year, heat of summer and cold of winter arising from different lengths of days and nights, and amount of heat received. (3) Prevalence of winds, whether from sea or land. (4) Disturbances of atmosphere in other parts.

III. *Local circumstances influencing weather.*

Position.—On high ground or in valley; on east or west of range of hills; whether sloping towards east or other point; whether surrounded by trees or on open bare plain; whether land is drained or cultivated, or swampy and uncultivated. Show how each of these affects the weather: Exposed situation colder than in valley, free to all winds. Ranges of hills condense vapour in westerly winds and cause it to be wet on one side of range and dry on the other. Compare Cumberland with Northumberland, Wales with Norfolk. Easterly slope cold from winds; southerly slope, mild, etc. Fogs prevalent in marshy places and near trees.

IV. *Method of ascertaining kinds of weather to be expected.*

(1) Observation in this and other districts. (2) Intercommunication. (3) Knowledge of physical laws affecting atmosphere. (4) Readings of barometer; barometric pressure.

V. *Weather as regards health.*—General instruction respecting health in different kinds of weather. (*a*) Freedom from cold. (*b*) To avoid damp. (*c*) Exposure to sudden changes of weather. (*d*) Directions respecting clothing, change of clothing, etc.

Music.

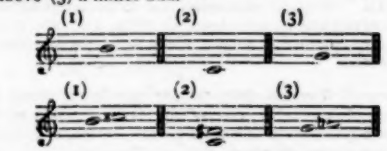
OLD NOTATION.

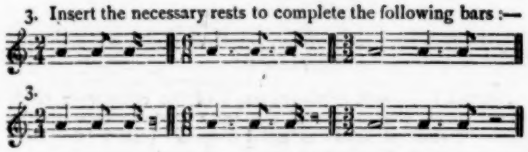
A quarter of an hour allowed for this Paper.

(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

1. Write in the Treble clef the ascending scale of A minor, using the sharp sixth and seventh.

1.

2. Write above (1) an augmented 2nd; above (2) a pluperfect 4th; above (3) a minor 2nd.

3. Insert the necessary rests to complete the following bars:—



TONIC SOL-FA NOTATION.

1. Write above (1) *soh* an augmented 2nd; above (2) *doh* a pluperfect 4th; above (3) *fe* a minor 2nd.

1. (1) *le*; (2) *fe*; (3) *soh*.

2. In the minor mode what are the different forms of the sixth and seventh, ascending and descending?

2. Ascending: (1) *fah, soh*; (2) *fah, se*; (3) *bah, se*.
Descending: *soh, fah*.

3. Re-write the following, trebling the value of each note and rest:—

|m .,m :r .,d |s :s |d ,d ,d :d |

3.

|m :- :m |r :- :d |s :- :- |s :- :- |d :d :d |d :- :- ‖

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